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Some Significant Steps in the Development of a National Service

From the address of Mr. H. B. Thayer before the Vermont Historical Society on June 24, 1925, at Montpelier.

THE first person to hear the human voice by telephone is still living. The first name to appear on the payroll of any organization giving telephone service is still on our payroll. A member of the first Board of Directors of the first telephone company still sits on our Board. It is still less than half a century since the invention of the telephone, so that what I have to say must be considered only a part of the first chapter of the history of telephone service.

The story of how Alexander Graham Bell a teacher of deaf mutes, a student and teacher of the laws of speech, as had been his father and grandfather before him, studied and experimented in the belief that the human voice could be carried to a distance by the electric current over a wire, has been often told. The story has all of the thrills of a romance: Picture this young teacher with a great idea

but with none of the financial resources necessary for experiment; then, after he had succeeded in communicating his enthusiasm in some measure to the fathers of two of his pupils, with financial help from them, working persistently, sometimes in a cellar, sometimes in a shop attic and sometimes in his boarding house—often with discouragements and only occasionally obtaining results which renewed his hopes, but always with faith that the thing could be done.

In June 1875—50 years ago—he first heard a sound which had been electrically carried over a wire. It was not the sound of the human voice but it was a sound.

In the following March, his voice was carried over the wire from one room to another in his boarding house and was heard by his assistant, Thomas A. Watson.

The theory was demonstrated: The invention, crude though the apparatus was, had been made.

His financial backers were Thomas Sanders and Gardiner G. Hubbard; and Mabel Hubbard, at first his pupil, had become the rival of the telephone in his heart and mind, and it was her encouragement which led him to go to the Centennial Exhibition in Philadelphia where the telephone was on exhibition (but had received scant attention), so that he was in attendance when Dom Pedro, Emperor of Brazil, who was being escorted through the exhibition, in company with some distinguished scientists, recognized in him the young teacher of deaf mutes whom he had previously met in his classroom in Boston and listened at the telephone receiver while Bell talked at the other end. "My God—it talks"—the Emperor exclaimed; then Joseph Henry, the venerable head of the Smithsonian Institution listened. He recognized in Bell, the young inventor who had told him what he was trying to do over a year before. Henry had then encouraged him to go on with his work. "But I have not got the electrical knowledge that is necessary," Bell replied. "Get it" was Henry's answer. He was followed by Sir William Thomson, afterward

known as Lord Kelvin, and at that time the foremost scientist in the world. "It does speak" Sir William said. "It is the most wonderful thing I have seen in America." Bell's fame and the fame of the telephone was made and heralded over the world.

In the following year Alexander Graham Bell and his pupil, Mabel Hubbard, who had helped him with inspiration and encouragement, were married and after forty-five years of happy married life, her death followed his by less than a half year. That is the romance of the invention of the telephone.

Laying the Foundations

The history of the development of nation-wide telephone service is the story, first, of a small group of men who foresaw possibilities and laid sound foundations for a great public service and who devised and constructed its plan of operations. These were achievements characterized by far more than ordinary foresight, sagacity and constructive ability and as such deserve and will receive our principal attention.

Professor Bell was a man of vision. As early as 1878, when the telephone had barely emerged from the laboratory, when speech by telephone was possible, but barely practicable, he wrote this:

> "It is conceivable that cables of telephone wires could be laid underground or suspended overhead, communicating by branch wires with private dwellings, country houses, shops, manufactories, etc., etc.—uniting them through the main cable with a central office where the wire could be connected as desired, establishing direct communication between any two places in the city. Such a plan as this, though impracticable at the present moment, will, I firmly believe, be the outcome of the introduction of the telephone to the public. Not only so, but I believe in the future, wires will unite the head offices in different cities and a

man in one part of the country may communicate by word of mouth with another in a distant part."

"Believing, as I do, that such a scheme will be the ultimate result of the telephone to the public, I will impress upon you all the advisability of keeping this end in view, that all present arrangements of the telephone may be eventually realized in this grand system."

The original patent on the telephone was owned in partnership by Thomas Sanders, Gardiner Hubbard and Professor Bell, Sanders and Hubbard being the financiers and business managers. They also were men of vision, thoroughly imbued with the plan of building up a national service. I have often wondered whether they would not have received greater material reward for their efforts if they had been content to manufacture and sell telephones and leave to someone else the future of telephone service, but judging from their correspondence, that thought did not enter their minds. With great personal sacrifice they put money into the business but there is no suggestion in their correspondence that they thought of taking any out. Apparently their whole purpose was to build up a business to give telephone service. Probably they were not entirely altruistic but were disposed to build and wait.

A real discoverer or a real inventor usually starts up a flock of claimants and pretenders, ranging from those who have almost accomplished the result, to those who, on no real foundation of fact, fabricate a case for the purpose of robbing the rightful winner of his reward. Professor Bell's experience was no exception. The announcement of his invention was followed by claims involving the greatest patent litigation up to that time, lasting about 20 years; that is, through the whole 17 years life of the original patent, and 3 years after it had expired. Some of these claims were taken up by the Western Union Telegraph Company and for the first two or three years, the infant industry found itself in competition with one of the most

powerful corporations of that time. The effect of this during the first two or three years was largely in increased difficulty in inducing men to put their time and money into the promotion of an entirely new enterprise. Both Mr. Hubbard and Mr. Sanders had other interests and other work, and they put into the business more money than they could really spare. They formed a corporation, but had difficulty in distributing the stock. They needed a business organization, but did not have the money to support it, but they needed most someone of force and ability to take the business management of the enterprise.

Developing an Organization

Mr. Hubbard, as a member of a Congressional Commission on Postal Affairs, had met Mr. Theodore N. Vail, who was then Superintendent of the Railway Mail Service and had become impressed with his ability, and he and Mr. Sanders rather reluctantly came to the conclusion that they could pay him $3,000 a year salary, although Mr. Sanders impressed it upon Mr. Vail that he did not personally guarantee its payment. The enterprise was having what we in Vermont call "pretty hard sledding."

At about this time, (in 1878) William H. Forbes of Boston became financially interested in the enterprise. Colonel Forbes was of one of the old Boston merchant families—owning its own ships and trading with China and the Far East. Perhaps he inherited a spirit of adventure which moved him to embark in this enterprise. It needed such a spirit. The Company was poverty-stricken and the resources of the Western Union Telegraph Company were concentrated against it.

These two men, Forbes and Vail, brought to the struggling business what was needed to put it on a firm foundation,—business sagacity, generalship and the confidence of financiers.

They settled the contentions with the Western Union Telegraph Company and soon the public began to realize

the possibilities in what had previously had little more than the attraction of a novelty. Their Company, the National Bell Telephone Company, had issued capital to the amount of $850,000. Within the year, from November, 1878 to October, 1879, the market price of the shares went from about $50 to $800 per share. That was the period in which the tradition that there was an enormous profit in the telephone business took root.

In the spring of 1880 The American Bell Telephone Company was organized under a special Act of the Massachusetts Legislature and it is significant that one of the prominent features of the charter was the right to hold stock in other companies: Significant because, as I shall attempt to show, stock ownership in subsidiary companies was one of the essential parts of the plan in their minds for the development and operation of a nation-wide telephone service.

Mr. Forbes became President and Mr. Vail, General Manager, of the new corporation. At that time, there were less than 30,000 telephones in service in the United States, and they were in 138 cities and towns, unconnected with each other by telephone lines. In Mr. Forbes' first report, with reference to this period, he said:

> "After two years passed in a struggle for existence and a third largely devoted to the settlement of disputes inherited from that contest, the owners of the telephone patents, at the beginning of their fourth year, for the first time find themselves free from all serious complications, with nothing to prevent the Company from directing its whole working force to the development of the business, and with a defined policy for its future operations."

Following a Fundamental Policy

There *was* a defined policy. During the following five years, the fabric of corporations and contracts defining their relations, departments and all that went toward

making a working system to carry out that policy, was constructed. The policy was to carry out the dream of Professor Bell—to construct and operate a nation-wide telephone service, so that within the boundaries of this country, all that is possible in telephone service should be possible to all.

The system as then constructed is substantially as now operated; a parent or headquarters company, sectional operating companies, a manufacturing organization and an organization to furnish service connecting telephone users in different operating districts—the system which we call The Bell Telephone System. How much of this constructive planning was the work of Forbes and how much of Vail, I cannot tell. I doubt whether they could have told, because they worked in such co-operation that much of it was undoubtedly joint work. They planned as though they were standing on the threshold of the future and could see then what would be needed now and in our future, for this National Service, and what must be provided and what must be guarded against to insure it.

Their plan provided district operating companies in touch with the growth and the requirements of the communities they served, with stock ownership by the parent company in order to insure uniform policies and uniform standards of service. At first there were many of these operating organizations but as economy of operation has dictated, they have been consolidated into fifteen operating organizations covering in their operations the whole country.

They recognized the importance of a uniform standard of excellence in the apparatus to be used in transmitting and receiving the voice current, and retained in the parent company the obligation to furnish to all of the operating companies the transmitter and the receiver.

They realized that in addition to the transmitter and receiver an almost endless variety of other apparatus must be provided, and their costly experience in patent

litigation warned them that the operating companies must be spared a similar experience.

They foresaw that they must have a free field of development, unhampered by patents controlled outside of the system.

Furthermore, they realized the desirability, on the grounds of economy and efficiency, of standardization of material.

They, therefore, organized in January, 1882, a manufacturing corporation, in which the parent company was a large stockholder, under obligation to provide whatever devices might be required by the operating companies at reasonable prices. This involved an obligation on the manufacturing corporation to acquire licenses under the patents of others, if necessary.

But, in order that this relationship should always be an advantage which the operating companies could use, and never a burden that they must carry, they left the operating companies free from any obligation to buy of their manufacturing company. This studious care to protect the operating companies in untrammelled development—to help and not to hinder—is characteristic of the whole plan.

It was planned and always has been the part of the parent company to perform for the whole system the functions of a general staff of the System. It has employed scientific investigators and maintained laboratories and experimental shops where the aim is to develop the most economical and efficient apparatus and construction and maintenance material, looking as far as possible into the future requirements of the public. All of the methods of work in the various departments of work are studied and standardized. It has co-ordinated the financing of the system and in general has done all of the things which could be done more efficiently by one agency for all of the companies, than by each for itself.

Building a Nation-Wide System

By 1885, the operating companies had made such development that it seemed possible to extend the range of conversations, and the American Telephone and Telegraph Company, entirely owned by the parent company, was organized to inter-connect the telephone users in the districts of the operating companies. When that was done, the plan for a national service, developed before 1882 and provided for in inter-company contracts, came into complete operation.

Counting from the invention of the telephone, the end of five years saw the plan completed, which has been followed, practically without change, in establishing the nation-wide telephone service as it exists to-day. The vision and the wisdom of the founders of the business, as exhibited in the work of that period, makes it stand out as the most noteworthy in the history of the telephone. The history of the telephone has been the fruition of the plans made then. What they did was to create an organization which was tributary to no outside interest, which had within itself the elements of progress and which depended upon nothing but itself and the good-will of the American Public. That is what they did, and the evidence is strong that that is what they tried to do.

That they realized their dependence upon the public's good-will is evidenced by a letter from the General Manager, Mr. Vail, to at least one of the operating companies written in 1883. Note the significance of the questions he asks:

> "Is the telephone service, as it is now being furnished, satisfactory to the public?"
>
> "Are the prices satisfactory to the public, considering the facilities and service that is given?"
>
> "Is it possible, in view of the contingencies of storm, under-ground legislation, etc., to make any lower rate to the public for same classes of service?"

"What has been the tendency of the relationship between the public and the local companies for the past year, i. e., are the relations between the public and the companies improving?"

Such solicitude as to quality of service, prices and public relations, unfortunately, was not as general among public utility corporations at that time as it is coming to be now.

So the founders of the service left to their successors not only a complete operating organization which has survived, but they left in the organization the right spirit of public service. Leaving this constructive period, I shall lay stress only upon such events as had an important influence upon the final result.

A Period of Healthy Expansion

It must be remembered that in the early eighties, not only was the art of telephony new, but that was true of all of the applications of electricity to the service of mankind, except the telegraph, and those years were marked by development of apparatus and materials, methods and men, and a healthy expansion of the business, hampered somewhat by the constant patent litigation.

In the Annual Report for 1892, the President says:

"It is now possible from this room (in Boston), or from any properly appointed station on this system, to talk north and east to Augusta, north to Concord, N. H., to Buffalo, New York, west to Chicago and south to Washington, and, of course, to the principal cities intermediate."

"It may be interesting to note that within that territory live and do business, something more than one-half of the whole population of the United States."

"That this constitutes an addition to the social and business facilities of the country of far reaching consequence, needs, of course, not to be added."

At that time, after about fifteen years growth, there were about 230,000 telephone stations in the United States (about as many as the present growth of three or four months).

In 1893 the original Bell patent expired although the litigation over it still continued.

The Company owned or controlled many other patents covering important improvements in the telephone or subsidiary apparatus, but never again made any serious attempt to enforce patent protection.

Patent protection had served its purpose by furnishing the measure of control or influence necessary to direct the introduction of the telephone in accordance with the purpose of a national service by a closely knit organization.

It should be borne in mind that the purpose of the major part of this litigation was not to determine whether or not there should be a patent monopoly of the telephone, but whether it should rest with the Bell Group, or go to some other group.

As the necessity of protecting its patent situation became less important, it was able to, and did liberalize some of its methods. It began to permit connection between its licensed companies and other companies without raising the question as to whether or not they infringed its patents.

That was the beginning of the connecting company as distinguished from the so-called competing company.

The Company was prosperous and the business profitable, but not extravagantly so. There was a popular opinion that it was something like a gold mine. I remember at times meeting men who claimed to have had the opportunity in the beginning to buy the Bell patent for trivial sums, and who were fond of calculating the millions they lost by not taking advantage of the opportunity. It was frequently stated that the patent was the most valuable one ever issued.

AN EXPERIMENT IN COMPETITION

The fact is, so far as I have been able to find, that no one ever had an opportunity to buy the Bell patent from the original owners, and while I think it was the most valuable one ever issued, the value was principally to the public. The profits in excess of moderate dividends were left in the business. No large fortunes were made out of it even by the pioneers. But this popular opinion that it was a very profitable business led people all over the country to establish so-called competing companies after the expiration of the original patent. Before long there was hardly a community in the country which was not served by two companies, each having a separate list of patrons and a few in common.

Perhaps this competitive movement was fostered to some extent by the general public feeling of revolt against large corporations which was at its height during this period. There was the feeling that with size went power and that there could not be power without abuse of power. This feeling manifested itself in onerous restrictions which were placed upon this Company by the Legislature with reference to increases in its capital, so that at the same time it stimulated public favor in the small corporation and hampered the operations of the large corporation.

In 1900 it became necessary to change the legal domicile of the parent company, which could be more properly called the headquarters company, and it was accomplished by transfer of the property to its subsidiary, the American Telephone and Telegraph Company, a New York Corporation, and the exchange of the shares of that company for its own shares. As a part of this legal reorganization, a part of the surplus which had accumulated in the preceding 25 years through undivided profits and the receipt of premiums on stock issues was capitalized, with a proportional adjustment in the dividend rate. The ownership and operation of the Long Distance Lines, which had been in a separate corporation, thereby came into the

parent company organization. Otherwise, it was virtually a change in name and in legal residence of the corporation with no change in management or policies or methods. The release of restrictions on the issue of new capital, however, made possible extensions which otherwise would have been impossible and at this time began the great growth in telephone service.

The telephone companies not licensed by, or operating as a part of the Bell organization, were called competing or independent companies, and between 1900 and 1905 they reached the summit of their strength. There are not accurate figures as to the number of stations they operated, but I have the impression that it did not at its height differ widely from the number operated by the Bell organization.

They did not have a central organization and a centralized financial strength. They did not have a complete scheme of inter-connection between communities and in many cases they were not soundly financed.

The principle of two agencies rendering telephone service in the same community or communities is economically unsound and could not survive. It has, however, taken a long time for the public to fully realize that this so-called competition is not real competition; that the public does not have the choice between two complete services but it either pays to one company for a partial service or to both companies in order to get a complete service in the community served. It is now rapidly disappearing. In some cases the Bell plant has been sold to the independents and in some cases the independent plant has been sold to the Bell Companies and in all of those cases the surviving company's plant has been connected with the Bell National System and so the ideal of a nation-wide service has been maintained.

The Telephone's Part in the War

By the time of the entry of this country into the great war, the Bell Telephone System had become really the

National Telephone System. Its wires reached from coast to coast and from Canada to the Gulf. It had the only laboratories equipped to design telephone apparatus for military purposes—the only manufacturing plants capable of producing it in adequate quantities, and the only large body of employees trained to do certain necessary kinds of service, and all of these facilities were promptly made available to Government use. Camps and cantonments and all of the various activities of the Army and Navy were promptly equipped and connected. Units were organized for service abroad in the various departments of telephone work. Special apparatus was designed and supplied. Both the intentions and performance of the Bell organizations received the hearty approval of the military authorities.

It came, therefore, as a surprise and somewhat of a shock when, under authority of Congress, the Federal Authority took over the operation of the telephone service. It did not appear to be justified and did not appear to result in any advantage.

It necessarily meant Government approval of rate changes and wage changes during a period when prompt action was vital to maintenance of good service. Governments do not act promptly and to that extent the service suffered. After the armistice the operation of the properties was returned to their owners. The unanimity of action possible in the Bell organization made all of the details of the transaction comparatively simple, and within six months of the return of the property to the companies, the whole transaction was closed.

The restrictions on the use of capital and material during the war, loss of morale and of skilled people due to slow wage adjustments during the period of Federal Control, all had their effects on the service to the public after the war, and from those effects the service has only recently completely recovered.

A history of the commercial development of the telephone in this country becomes in the main a history of

the Bell Telephone System. It is very rare that those engaged in the management of an enterprise can look back after the lapse of a half century and find that its progress during that period has been in accordance with a preconceived programme, and that no fundamental mistakes were made in the conception of its future, or in the preparation for its future. We can even go beyond that and say that we cannot see any other way in which a nation-wide service can be efficiently and economically operated.

The Realization of Early Foresight

Foresight has been characteristic of the management and in other ways than I have attempted to describe. The story of the work of the scientists and inventors employed in the Bell System preparing for the growth of telephone service and its extension into new fields makes a wonderful record. I have already called your attention to the early appreciation of the fact that approval by the public of the policies and practices was essential to the continued success of the enterprise. The American Telephone and Telegraph Company was at least among the first of the great corporations to give full publicity to its aims and its operations.

The financial management has been sound and conservative. The stockholders, through premiums and conversion of bonds, have paid into the treasury over $40,000,000 more than the capital of the Company. Reasonable dividends have been paid. If figured not upon the issued capital but upon what the stockholders have paid into the Company, plus their earnings undistributed, the rate in 1924 was 7.3%. It has not exceeded 7.5% in the past 30 years and has exceeded it only for two years in the past 40 years. It has not been at the rate of less than 6% in 20 years and only for two years in the past 40 years. The aim has been that the stock should be an investment and not a speculation.

Fair and considerate treatment of those giving their services to the enterprise has been a cardinal principle. In 1913 there was inaugurated throughout the Bell Telephone System what is called The Benefit Fund, providing payments to employees during sickness and in old age. In 1915 plans were put in operation encouraging employees to invest in stock and securities of the Bell System and other plans for the encouragement of thrift are in operation. A separate department—well organized and equipped—is devoted to the study and inauguration of plans for improvement of working conditions, and in working conditions is included something more than physical conditions. The effort is made to give all of those employed in giving telephone service that knowledge of the aims and purposes of the organization, and of the results of operation which will give them an interest in their work, and a share in the joys of accomplishment. I have only touched upon the later and incidental developments because I want to leave in your minds the picture of the work of the founders of the service in developing a plan which, after a half-century's use, must be admitted to be the best plan for conducting a nation-wide service.

Now let us see what in less than a half century has come to this country out of the dreams of Bell and Sanders and Hubbard and the plans of Vail and Forbes.

The Bell Telephone System with its investment of between two and a half and three billions of dollars, contributed directly by 360,000 stockholders, and unknown thousands of holders of other securities, and indirectly through savings banks and insurance companies, and other similar institutions, by perhaps millions more, giving employment directly to about 300,000 people, and indirectly to thousands more.

With sixteen millions of stations in the cities, towns and villages and on the farms all over the country connected together in one great network of intercommunication, and used to the extent of over 60 million conversations a

day, some of them between points thousands of miles apart. And the end is not yet.

Aside from the probability that there are more Vermonters financially interested in this than in any other single business enterprise and more Vermont communities using this than any other public utility, there is another reason why the development of the Bell Telephone System should have a particular and personal interest to Vermonters.

It is a monument to the foresight and constructive genius of Theodore N. Vail, and Mr. Vail was a Vermonter. A Vermonter by adoption, it is true, but as he often said, the glory of being a Vermonter was greater to him who gained it by deliberate choice than to him to whom it came as an accident of birth. He maintained a residence here during the greater part of his business life. It was the home to which he turned for rest and mental refreshment. He was a truly great man—one of the giants of his generation—and he loved Vermont.

Progress in the Utility Field

THE change in the value of the dollar made many business adjustments after the war inevitable. These adjustments are not yet completed in the utility field. The prices which every public utility has been obliged to pay on account of the new plant which it has been compelled to build, as well as on account of its expenses of operation, automatically adjusted themselves to the current dollar, which, measured in what it will buy of labor or materials, is worth much less than the dollar of 1914. This means that the prices of what the utilities must buy increased very largely. The utilities were not able to more than partially meet this situation through economies in operation. To balance their budgets, they were compelled to readjust their charges for what they had to sell in the direction of the general changes in prices. These readjustments are approaching completion.

They have been working an indirect but very substantial benefit affecting the entire public utility field. Out of them and the discussions which they have involved, there is coming a better understanding by both the utilities and their customers of the fundamental principles which underlie their business. This better understanding, of necessity, makes in the direction of more firmly established stability and security.

The business of a public utility is governed by the same fundamental principles which govern every other business. Many, perhaps it would not be an exaggeration to say most, utilities themselves have failed to appreciate this; but a start has been made in their education, and what they are learning is passing on to their customers. The operation of economic laws is the same, whether what is under consideration be buying and selling groceries or buying and selling the services of a public utility. The stability and permanency of the business of a public utility depend upon the same factors

which determine the stability and permanency of any other business.

Preeminent among these factors are two. First, whatever the business furnishes must be of such recognized utility as to guarantee a steady and persistent demand for it. This proposition demonstrates itself. As an illustration of one extreme, take the business of manufacturing and selling mah-jong sets. For a time the game was extremely popular and this business grew like a mushroom; but this interest in the game suddenly died out and this business died as suddenly. On the other hand, take sugar. The demand for it will never cease, and the business of producing and selling it will never stop.

Value Must Exceed Cost

A second fundamental factor is that the business must afford a profit to both the producer and the consumer; and to permit this the value to the consumer of what the business produces must exceed what it costs to produce and sell it. And as a necessary element of this cost, there must be included the expense incident to securing the capital necessary to carry on the business, including both the present investment and new money needed for new plant.

Where this cost of producing and selling something is, say, $5.00 and its value to the person who buys it is, say, $7.50, or $10.00, or $15.00, it is perfectly obvious that its sale at a price in excess of $5.00 will afford a profit to the person engaged in producing and selling it, which if large enough will furnish a sufficient incentive for its production and sale. It is just as obvious that if its value to the person who buys it is $7.50, or $10.00, or $15.00, and he can buy it for a price appreciably less than this, say, in the first case $6.00, in the second $7.00, in the third $7.50, on his side of the transaction he will have a sufficient incentive to buy because every purchase up to the limit of his requirements will afford him a profit. Sound trades, upon the average, must benefit

both parties to them. This fundamental proposition lies at the basis of all business and commerce.

It is also self-evident that the greater this spread is between this cost of producing and selling and this value to the one who buys, the stronger is the assurance it furnishes of stability in the business. If this cost of production were $5.00 and this value to the person purchasing were only $5.25 or $5.50, the margin of profit which could be divided between the producer and the purchaser to furnish the incentive for the transaction of the business would be relatively small and might be wiped out by corresponding changes in conditions, so that the business could not continue; but where this margin is large, it makes it possible to meet such changes without wiping out this margin of profit and so without endangering the stability of the business. Incidentally, what any business contributes to society is the excess in the value to the consumer of what he buys over the price which he must pay for it.

These matters of very elementary economics—for "economics" you may, if you prefer, read "common sense"—while they are extremely simple, have not been appreciated by the utilities themselves or by their customers. But this condition is changing. The agitation and discussion incident to this post-war readjustment have sharply directed attention to these questions. Both the utilities and their customers have been going through a process of education. It may seem slow, but there is distinct and continuous progress. And investors who have had faith in the businesses of the utilities are adding to this faith an understanding of the basic reasons why these businesses are inherently sound; and the necessary tendency of this better understanding is to confirm and increase their faith and confidence.

Turning back to the first element of stability that has been mentioned, there is no question about the usefulness of the service furnished by public utilities. It is the basis of the term "utility". These services

have so thoroughly demonstrated their value that they have come to be commonly designated as necessities. There is, therefore, complete assurance of the continuous and persistent demand, which is one of the fundamental elements of a stable business.

Passing to the second element, and speaking generally, the value of these services to those who use them is so great that, in some instances at least, it would not be an exaggeration to say that it not only largely exceeds but is many times this cost of their rendition. This presupposes that there is an economic justification for the utility in the locality which it serves. There have been a few instances of unwise promotions, especially in cases of electric railways, where it has been necessary to discontinue the business because the operation of the property has demonstrated that the value of the particular service to the particular community was less than this cost of furnishing it, and that consequently the service could not be furnished except at a loss. But setting to one side these few exceptions, it may be most positively asserted that the value of these services generally very greatly exceeds this cost of rendering them. If any demonstration of this were necessary, it could be found in the conditions which arise when one of these services is temporarily interrupted, or when the facilities for furnishing it are inadequate so that it cannot be furnished promptly to all who desire it. The interruption or absence of the service demonstrates a demand for it that at once and beyond any question proves its value and very great convenience. Under such circumstances, the question immediately becomes, not what is the price of the service but whether and how soon the service can be obtained. This is conclusive evidence that in the minds of those who buy the service, its proved value is much more than what they pay for it.

Going one step further, if I am right in asserting that the value of these services to those who use them greatly exceeds the cost of rendering them, then in any case

where it further appears that the utility is doing business without profit but at a loss, it is clear that this profit which is essential to the transaction of the business is not being equitably divided, but that all or more than all of it is going to the person who buys the service. Such a condition is unsound, because it violates these fundamental economic laws and therefore cannot continue.

As has been said this better understanding of the things underlying the business of public utilities has tended toward greater security and stability because it has confirmed in the people, generally, their belief that the underlying structure of these businesses is sound. But it has done more than this; it has been of substantial benefit in the great field having to do with the regulation of public utilities.

Capital Secured in Competition

Not only the commissions but the customers of the utilities as well are beginning to understand that a public utility in our growing communities must constantly build new plant if it is to render adequate service, and that on account of this plant there must be a continuous investment of new capital. They are beginning to understand that this new capital must be secured in a competitive market, where the utilities are compelled to bid for it in competition with all other enterprises. Present day facilities for transportation and communication have made this competition not local, or national, but international. Understanding these things, it has become obvious to them that capital will flow into those investments which, taking into account profits and safety, on the whole, are the most attractive. So that it is now pretty generally understood that in this aspect the public utilities are exactly upon a parity with every other business, and that if they are to secure the money which is absolutely essential to enable them to carry on their enterprises successfully, it must be because investors are satisfied, taking into account differences in risks and other

factors affecting desirability, that the investment in the public utility promises to be at least as profitable as other available investments.

It is becoming generally understood that it is the investor, the man who has the money, who in the final analysis controls this situation. It is he who determines what he will accept as a fair return for his money, not some court or some commission. All that the court or the commission can do is to examine the facts and from these facts deduce its conclusion as to what the investor has fixed as this return. The money is the money of the investor. It is his, in his possession and under his control. He naturally and properly will invest it in the securities which he believes, all things being considered, will return to him the greatest profit. He determines this question for himself. He decides what return will induce him to part with his money. No court and no commission has any control over his decision of this question. And so, it is coming to be generally understood that investments in public utilities must be tested by exactly the same rules which are applied to other investments, and that the impression that money invested in a public utility is not entitled to earn relatively as much as money invested in other businesses is entirely a misapprehension.

Service Depends upon a Fair Price

With the understanding of these things there has come a clearer understanding of what may be accomplished by regulation, and of what it can not accomplish. Not only the commission but the utilities and the patrons of the utilities as well have been learning that there is no way to obtain good, efficient or economical service from a public utility at less than its cost, including, as has already been said, the cost of the necessary capital. In the long run, no effort to get something for nothing can succeed. It has become apparent that to attempt to do this through the exercise of regulatory

powers is worse than futile. The attempt must not only inevitably fail, but in addition, its certain result is a very substantial increase in the cost of the service, as well as a tendency to disturb and disrupt the relations of confidence which must exist between the utilities and their patrons if the very best results are to be attainable.

The average man is fair and honest and is endowed with common sense. His common sense conclusively demonstrates to him that no public utility can or will go on producing and furnishing the service which he wants at less than its cost, that is, at a loss. He cannot do this in his business, and he knows they cannot do it in theirs. His sense of honesty and fairness is such that he does not wish or expect it. He is willing to pay a fair price. What he demands in return for it is good service and frank treatment. He properly resents being imposed upon. He wants to be assured that the facts are fairly disclosed to him. He is willing to accept regulatory action where that action is the result of common sense applied to the facts. He knows that in the long run this will benefit him probably more than it will benefit the utility. The notion that whatever injures the utility benefits its customers is being supplanted by the sounder rule of cooperation.

The utilities have had as much to learn as their customers. Perhaps, like the average student, neither has taken full advantage of its opportunities, but both are making progress. I believe that this better understanding of the business—this approach to understanding that the business of public utilities is subject to the same economic laws that govern every business, and that the function of regulation is not to attempt to overturn these laws but to facilitate their operation—is the most marked and most important development in the utility field today. Inevitably, its tendency is to strengthen the utilities, to aid them in their efforts to give better and more efficient service and to directly benefit all of their patrons.

N. T. GUERNSEY.

Bringing Telephone Service to the Deaf

AMONG the thousands of improvements in apparatus, equipment and methods which have been developed in the Bell System, those which have been perfected to aid people of defective hearing would have peculiar interest for the great humanitarian, Dr. Bell, whose name the System bears.

If Alexander Graham Bell had not been a pioneer in improving the condition of the deaf, he might never have invented the telephone, and if the Bell Laboratories had not constantly sought to improve the telephone, they would not have made such substantial contributions to the "deaf set" and other aids for those afflicted by impairment of hearing.

To those not associated with the telephone industry, the name of the mechanism called a "deaf set," suggests little of the romance of its accomplishment. Like "wall set" and "desk set" outstanding developments of an earlier day, it merely hints that a number of elements have been brought together and combined to form an efficient and convenient unit of telephone equipment.

But to telephone men and women the name recalls Bell's life-long devotion to the cause of helping the deaf, —his teaching of "visible speech" to the deaf, first in England and then in Boston, and the long endeavor to perfect a "harmonic telegraph," during which his experienced ears detected the electrical significance of a sound that had been accidentally transmitted over a wire.

The name of "deaf set" brings to mind the Centennial Exposition in 1876 where Bell's modest telephone exhibit was ignored until the Emperor Dom Pedro saw and recognized Bell, not as the inventor, but as the teacher and friend of the deaf, and in greeting him as such, drew to him and to his invention the attention of scientists

whose judgment was an elixir of encouragement to the inventor and his supporters.

It particularly recalls Bell's winning of the Volta Prize, awarded by the French Government, in 1880 and his use of the $10,000 which accompanied the award in founding the Volta Laboratories, where he and two scientific friends carried to a successful conclusion many important pieces of research work. Bell's own investigations were largely along lines definitely aimed at assisting the deaf and were not financially remunerative. Certain other work done in the laboratories produced revenues out of which, in 1887, the sum of $100,000 was appropriated for the financing of the Volta Bureau for the "increase and diffusion of knowledge relating to the deaf." This institution has made and is making important contributions toward the great work of aiding those of defective hearing.

The name reminds those who are familiar with Dr. Bell's career of such far-reaching results of his work for the deaf as the American Association for the Promotion of Teaching Speech to the Deaf, which the telephone's inventor helped to organize and to which he gave large sums. It recalls, in short, a life centered around a humanitarian interest in all things that promised to make life happier for those who could not hear.

And so the development of a deaf set capable of being incorporated in the intricate telephone system of today, for use by those to whom the regular subscriber's set is almost or entirely useless, seems like the consummation of a search begun half a century ago,—rich fruitage of a life full of service to humanity. Bell System workers will always take deep satisfaction in knowing that the result, if scientifically possible, was inevitable in the functioning of the organization that bears Bell's name and that has been from the beginning the trustee of his great discovery and invention,—and his idealism.

The Deaf Set—A Product of Telephone Development

The deaf set that is now available for installation by the Bell companies for subscribers of impaired hearing is definitely a product of telephone development. It employs a principle that has been a vital factor in extending the range of the telephone. Its most important element is a vacuum tube which has the effect of amplifying the current reaching the subscriber's end of the line and thus of increasing the sound produced by the vibration of the receiver diaphram. In fact, it is a "telephone repeater," quite similar in purpose to the repeaters that, by amplifying the attenuated currents on the transcontinental line and on other long Bell System circuits, make possible the range and quality of modern long distance service. The vacuum tube which it contains gives a power amplification in reception varying from nothing to 100-fold in steps under the control of the user.

Not Useful for Those of Normal Hearing

Of course the deaf set, as its name implies, has been designed only for those having impaired hearing. It has little or no value when used by people of normal hearing. Since it amplifies all sounds approximately equally well, the effect of any noise currents in the telephone receiver caused by inductive effects in the telephone lines or by noise in the room is amplified in the same proportion as the effect of the voice currents. Furthermore, the amplified sounds may be so loud as to produce two different effects upon a person of normal hearing. First it may overload the ear to the extent of causing the perception actually to decrease, and secondly, it increases the side tone from the user's transmitter. This might cause him to decrease the intensity with which he is speaking, thus reducing the volume of sound transmitted to the listener at the other end of the circuit.

The set should accordingly be used only by those for whom it is intended and for whom it will prove beneficial. Of course, the totally deaf will not be aided by it. Indeed a careful test is always made before a deaf set is installed in place of the ordinary telephone station equipment in order to determine whether it will meet the requirements of the prospective user. Special equipment is provided for this purpose.

Since the new apparatus was made available, a number of telephone users have tested its usefulness in this way and have had the sets installed in connection with their telephones. They have found that the device has enabled them to overcome in part the handicap of impaired hearing and has made available for them the universal, nation-wide telephone service which millions of their fellows are enjoying.

The Audiphone

But the device which enables the deaf to make use of telephone facilities is by no means the only product of the research work done in the Bell Telephone Laboratories on behalf of those of impaired hearing. There has recently been perfected a portable deaf set known as the audiphone, which makes it possible for partially deaf users to take part in direct conversation. Indeed, a person having a 60% impairment of hearing can, with the audiphone, follow conversation at normal tones when the speaker is about three feet away.

The essential parts of this portable device are the microphone, which is hardly larger than a lady's Chatelaine watch; a light weight receiver, which is designed to fit into the ear; and the amplifying mechanism, which consists of two tiny vacuum tubes and other necessary apparatus including batteries.

The case containing the amplifying mechanism is compact and conveniently carried. The microphone transmitter may be attached to the coat or other cloth-

ing, or, if desired, set on a small movable mounting that may be placed upon a table.

The receiver is particularly interesting. Each user is "fitted" for his own individual receiver, an impression of the convolutions of the exterior ear being taken with plastic material and the receiver-support being cast in hard rubber from this mold. The cartilages of the outer ear are sufficiently rigid to support the light receiver when the latter is slipped into place.

In perfecting the audiphone receiver, use has been made of permalloy, a highly magnetic metallic combination developed as a result of extensive research in another branch of the Laboratories.

Research in Behalf of the Deaf

To say that years of research effort in the Bell Telephone Laboratories are back of these devices perfected to aid the deaf, is merely another way of stating that the devices result from the laboratory method of telephone development, which consists in knowing all that is discoverable regarding everything appertaining, however remotely, to the communications problem. The telephone art as it exists today in America results from this method of scientific thoroughness. The deaf set is thus a particularly striking exhibit of the advanced state of this art because it makes telephone service available to those who otherwise could make no use of it.

Some reference to this laboratory work is needed for a proper appreciation of this new mechanism. It is not enough merely to describe the set as consisting of a vacuum tube and supplementary apparatus, for vacuum tubes have become commonplace items in homes equipped with radio receiving sets, and already are popularly accepted as standardized items of merchandise with little thought given to their principle, functioning or history.

Altogether apart from the years given to vacuum tube

development by the scientists of the Bell Telephone Laboratories, are the investigations into the nature of sound, the properties of speech, and the factors which determine the degree and accuracy of the sense of hearing.

These investigations have naturally long been fundamental in the Bell Laboratories in the interest of improved telephone service, since the purpose of the telephone is the electrical communication of sound. At first the study of sound as applied to speech was the nucleus of these investigations, but with the application of the vacuum tube to telephony, both by wire and wireless, as undertaken by the Bell scientists nearly fifteen years ago, new vistas of research were opened. The use of such a sound amplifying device not only immediately brought new problems connected with the transmission of speech and music, but also suggested that amplification principles might be utilized toward helping the deaf to hear. For the Laboratories, therefore, the study of the normal or impaired functioning of the human auditory system was a self-written prescription.

During the progress of this research, an important device, known as the audiometer, was developed among others. This is a precision instrument capable of measuring the acuity and the quality of hearing. Its development was undertaken by the scientists of the Bell Laboratories, in co-operation with members of the medical profession, when advance research work pertaining to sound demanded some means of measuring normal and abnormal hearing. Another motive for carrying on this development was the realization that any apparatus for accurately determining the condition of hearing would be a valuable contribution to the application and the increase of medical knowledge.

As a result of this development three types of audiometer were perfected—one, now catalogued as Type 1-A, being designed to fulfill every requirement for delicate functional and diagnostic measurements of otologists. With a pitch range extending from 32 to 16,384 double

vibrations per second and an intensity range covering approximately the entire hearing range, or from below the so-called threshold of hearing to that of feeling, its usefulness to highly specialized workers in hospitals and medical schools can hardly be overestimated. The other two types of audiometer are portable and are equally accurate for measurements for smaller ranges of pitch and loudness.

Another type commonly referred to as the "phonograph audiometer," is particularly useful in schools or industrial employment offices where many subjects may be simultaneously tested for their ability to distinguish speech sounds.

As a result of experiences with audiometric measurements of thousands of cases during the research connected with the development of the audiometers, there was also developed a means of recording these measurements so as to make a picture indicating at a glance the condition of the patient's auditory sense. Such a picture takes the form of a chart or "audiogram."

The audiometer is a by-product of telephone development that is certain to become increasingly useful wherever institutional or industrial conditions make accurate hearing tests desirable or necessary. A suggestive summary of its application may be read in "Audiometric Measurements and Their Uses," a paper presented before the section on otology and laryngology of the Philadelphia College of Physicians by Dr. Harvey Fletcher, of the Bell Laboratories, whose noteworthy studies materially advanced the successful development both of the audiometer and the deaf set.

Equally suggestive, both of the extent and of the humanitarian value of the researches on behalf of the deaf carried on by the Bell Laboratories, are some of the other papers that have been prepared by the Bell System scientists who have taken an important part in developing these devices. Of special importance and interest are "The Frequency-Sensitivity of Normal

Ears," by Harvey Fletcher and R. L. Wegel, in the *Physical Review* for June, 1922; "The Nature of Speech and Its Interpretation," by Harvey Fletcher, in the Journal of the Franklin Institute, for June, 1922; "Physical Examination of Hearing," by R. L. Wegel, in Proceedings of the National Academy of Sciences for July, 1922; "The Relative Sensitivity of the Ear," by Donald MacKenzie, in the *Physical Review* for October, 1922; "The Binaural Location of Complex Sounds," by R. V. L. Hartley and Thornton C. Fry, in The Bell System *Technical Journal* for November, 1922; and "Analysis of the Energy Distribution in Speech," by I. B. Crandall and Donald MacKenzie, in The Bell System *Technical Journal* for July, 1922.

Work on behalf of the deaf is perhaps more specifically humanitarian than are some other phases of telephone research, but it does not differ from them essentially in purpose or result. For the purpose of all such research work is service to man, that barriers to intercommunication may be overcome and all members of the human family be brought closer together.

W. P. BANNING.

Public Relations of Foreign Telephone Systems

THE Chamber of Commerce of Paris adopted, some time ago, a resolution urging the French government to take steps to transfer the government-owned telephone service of France to private enterprise. This proposal was advanced by the Chamber of Commerce only after full discussion. The reason offered for the suggested change was that the French telephone system is inferior to those of other countries, both in equipment and in organization. It was also asserted that the government has neglected to popularize the telephone in France; and the fact that the telephone service results in an annual charge on the French budget was cited as proof that the state is not qualified to operate the system on a commercial basis.

A similar resolution has since been adopted by a general meeting of French Chambers of Commerce, at which a hundred and forty chambers were represented.

A Significant European Movement

This movement in favor of private ownership of the French telephone service, press reports declare, has found support among trade associations throughout France. It is especially interesting as part of a general European movement. In 1924 Greece granted to a British syndicate a sixty-six year concession for the installation and operation of a modern telephone service throughout that country. Spain, too, has lately turned over her government telephone lines to a company which is consolidating them with other Spanish telephone systems and extending and developing the service into a comprehensive, privately-owned and operated telephone system for the entire kingdom. The Italian authorities have arranged for the sale to private companies of the government-owned local telephone systems of Italy. Poland, a couple

of years ago, turned over her government telephone facilities in several cities to a private company, retaining only a minority interest in the corporation. Recently it has been reported that the Polish government has determined to transfer the State telephone works at Warsaw, also, to a private concern. Germany, while retaining title to her government wire systems, has reorganized their administration on a basis analogous to private enterprise.

The current drift in European sentiment away from public ownership is doubtless attributable in some degree to the desire of the taxpayers in various countries to be rid of the burden of publicly owned enterprises producing recurrent deficits. It finds a sharper stimulus, however, in widespread popular dissatisfaction with the relatively restricted extent and inferior quality of service furnished by many government utilities. The requirements of modern business and social life are not best served by those nationalized telephone services in which continuous operation is confined to the larger cities, in which long distance calls are "booked" on a waiting list, or in which "urgent" calls are expedited only upon the payment of several times the ordinary rate. It is not surprising, therefore, that public opinion in Europe should exhibit a tendency toward adoption of the American policy of looking to private initiative to build up and operate an efficient telephone service. It is natural that, in seeking a solution of their telephone problems, other countries should consider the example of the United States where the telephone has attained a higher development and a greater degree of usefulness than in any other country in the world.

What American Initiative Has Accomplished

America's marked preëminence in the telephone field is recognized everywhere. It has been achieved under the system of private enterprise. Private initiative has

here stimulated not only a notable administrative efficiency, but also an extraordinary technical progress.

This point was emphasized by Professor Michael Pupin in his recent autobiography. He pointed out that the Bell System employs several thousand persons, at an expenditure of millions of dollars annually, in research and development work; and added that it is not so much the occasional inventor who nurses a great art like telephony and makes it grow beyond all our expectations, as it is the intelligence of a well-organized and liberally supported research laboratory. "When I think of that," Professor Pupin continued, "I am perfectly convinced that very few of the great advances in the telephone art would have happened under government ownership. That explains why telephony is practically dead in most European countries. What little life it has in Europe is due to the American research in the above mentioned laboratories."

Private enterprise, indeed, can claim credit not only for most of the remarkable technical progress that has been made in the telephone art, but also for notable achievements in the realms of telephone administration and operating technique.

An interesting tribute to America's leadership in this respect was paid in the French Senate some time ago. Speaking of the telephone and telegraph companies in the United States, one of the French Senators expressed the opinion that American operating methods give the public a service far superior to that afforded by the French government telegraph system, and even further in advance of the French nationalized telephone service. This superiority the speaker attributed largely to the fact that, under private enterprise, the management must be efficient and economical in order to maintain the prosperity of the enterprise and retain the confidence of the stockholders. He also called attention to the fact that the American companies encourage good service by the employment of telephone and telegraph executives

who "are well paid,—better paid than the engineers in the service of the State."

The complaint that government salaries are not adequate to secure the services of the best engineers and administrators has cropped up again and again in connection with publicly owned utilities in many countries. In view of the incalculable value of thoroughly competent management in business enterprises of any kind, it is unfortunate that a penny wise and pound foolish policy should have survived in the personnel administration of so many governmental undertakings.

Political Activities of Government Employees

In some countries the relatively low pay in public employment has been prominent among the causes which have incited government employees to political activity. Government departments have, in fact, been subjected to political pressure for various purposes and in various ways. In many cases employees on the public payroll have not hesitated to appeal to their Parliamentary representatives for support in differences with their superiors in the organization. It was this condition, doubtless, which led the British Post Office Department to report to a Select Committee of the House of Commons, some years ago, that owing to Parliamentary pressure the government was obliged to tolerate in its employees a degree of inefficiency which in private employment would lead to dismissal.

Similar conditions have obtained for years in other countries. As long ago as 1908, the then Secretary to the Postmaster-General's Department of Australia, testifying before a Royal Commission on Postal Services (which include the telephones and telegraphs as well as the mails), denounced "the agitation in Parliament on behalf of the officers of the Department." This agitation, he declared, "if continued, must be subversive of proper discipline, and in every way detrimental to the

best interests of both the officers and the Department." Years later, however, the "treatment of the employees of the Postmaster-General's Department" was a subject of discussion in the Australian Parliament. The political pressure that can be exerted by large bodies of organized civil service employees is a potent reason for confining governmental activities to strictly governmental functions, thereby keeping the number of persons on the public payroll at a minimum.

Public Relations of Government Monopolies

Not only in their dealings with their own employees, however, but notably in their relations with the public, government-owned utilities have frequently failed to attain the standard set by enterprises under private ownership and operation.

The reasons for this are not far to seek. The exercise of power is an essential element of government. Yet the exercise of power too often breeds in officials a habit of authority, which they find it difficult to relinquish. On the other hand, the administration of a public utility, to be satisfactory, must be animated by a spirit of service which places special emphasis on the interests of the utility's patrons. When, under public ownership, government officials are placed in charge of public utility operations, the habit of authority is all too prone to handicap the spirit of service.

Of course, no large utility,—foreign or domestic, public or private,—is entirely immune from criticism. The public relations of such an undertaking, however, are largely determined by the manner in which it handles the misunderstandings and complaints that inevitably arise in connection with any extensive enterprise.

A private concern cannot be genuinely successful in business without the good will of its customers. It has, therefore, every incentive to earn that good will by courteous and efficient service. When complaints do

arise, the company has a vital interest in adjusting them promptly to the satisfaction of all concerned.

A government department, on the other hand, is backed by the taxing power, and is consequently less under the compulsion of the ordinary business necessity to show a balance on the right side of the ledger. It is not necessary for it to keep the enterprise on a sound business basis by cultivating the good will of the public. If the department loses money the Treasury can make it up. There is, therefore, a lack of the economic incentive which impels a private company to strive for the betterment of its service and for the prompt adjustment of such complaints as may arise.

Moreover, governmental organization, in its very nature, tends to a shifting of responsibility, since those who exercise the ultimate authority in the administration of the public services hold office under the uncertain tenure afforded by a temporary political ascendency. It is this fact, probably, more than anything else, that accounts for conditions in various foreign telephone services which the newspapers of these countries themselves characterize as "bureaucratic." Under these circumstances it is not surprising that the public relations of governmental organizations are often less satisfactory than those of business enterprises under private ownership.

A letter published some time ago in one of the best-known Continental newspapers, described complaints addressed to the government telephone administration in the writer's country as a waste of breath and of ink. This sentiment has been echoed with variations in the newspapers of many lands during the last few years. In some countries it seems to have become so widespread as to produce an unfortunate effect upon the attitude of the general public toward the government-owned telephone service.

Official cognizance of unsatisfactory relations between a nationalized telephone system and its public was taken in the Report from the (British) Select Committee on the

Telephone Service, 1922. "No one acquainted with the evidence before your Committee," the report declared, "can fail to be struck with the almost universal antagonism—often, it may be, unreasonable—manifested so widely and persistently against British telephone administration. * * * * The public have little mind to help the Post Office, which we think unfortunate; the Post Office, on the other hand, have given some ground for saying that it appears to believe that the public was made for the Post Office, and not the Post office for the public. It tends too much to a cast-iron application of regulations in an improper way. We do not wish," the Committee added, "to lay undue stress upon these characteristics, but we cannot leave them out of sight in submitting this Report."

Political Pressure from Business Interests

Popular antagonism too often finds expression in political activity. In fact, political pressure brought to bear from without is a significant feature of the public relations of government telephone systems in various countries.

In practice, political agitation regarding telephone management abroad emanates from various sources. "It is to be hoped," said a recent British newspaper article regarding a change in the local telephone organization which had been decided upon by the Post Office Department, "that the business community will exert pressure to try and avoid the carrying out of the present intention. Only by this means, supplemented, as it should be, by the influence of the local Members of Parliament, can there be any hope" of dissuading the Department from its decision.

Local organizations of business men have frequently been instrumental in bringing Parliamentary pressure to bear on government telephone administrations in various countries. "The complaints of the public, which

grow in number and insistency every day, are echoed in the press and in discussions of General Councils, Municipal Councils and Chamber of Commerce," wrote M. Laffont, Deputy and Under-Secretary of State of the French Postal, Telegraph and Telephone Administration, a couple of years ago. He added that internal conditions had led to the drafting of several bills for the improvement of the telephone service, then under discussion in the Chamber of Deputies. Within the last year, however, press despatches from Paris have reported that the unsatisfactory condition of the French telephone service is attracting the close attention of Chambers of Commerce and other economic organizations throughout France. Resolutions, it is said, have been passed by trade associations all over the country demanding that the telephones be handed back to private enterprise.

In Great Britain, Australia and elsewhere, as well as in France, Chambers of Commerce have been active in pressing the case for better telephone service. They are the logical representatives of business telephone users. There can be no objection to their urging the claims of their members either by direct negotiation with the telephone management or in any other legitimate way. Where the telephone service is a government monopoly it is only natural that Chambers of Commerce should carry their complaints to Parliament.

Organizations of Telephone Subscribers

An Association of Telephone Subscribers was formed in France as early as 1904 for the express purpose of securing an improvement in the telephone service, and in particular of pressing the complaints of its members against the Postal, Telegraph and Telephone Administration. Some years ago this Association claimed credit in its official journal for having induced the administration to liberalize the regulations affecting telephone subscribers, to set up a training-school for telephone

operators, to adopt the common-battery system, and to extend the telephone service by the erection of new toll lines and the establishment of new exchanges. The Association frankly included among its achievements the fact that it had got in touch with Parliament, had secured the presentation of several petitions to the Chamber of Deputies, and had inspired several questions addressed to the government by Members of Parliament. Finally, the Association declared, it had established many excellent contacts with the press of all parties.

In Great Britain, also, a so-called "Telephone Users' Protective Association" was organized some months ago. Of greater significance, probably, from the standpoint of its effect on the public relations of the British telephone service, is the still more recently organized Telephone Development Association. This Association is composed mainly of British manufacturers of telephone apparatus and supplies. Its object is to popularize the telephone in Great Britain. An English technical periodical described the new Association as "frankly composed of manufacturers, whose only immediate customer is the Post Office," but added that "they rightly recognize that their ultimate clients are the general public, and as the interests of the latter will undoubtedly be served by the efforts of the Association, we wish it every success in carrying on the propaganda which, as we have pointed out, the Post Office has not seen fit to undertake."

This comment is typical of the favorable reception accorded the new movement by the British press. For years, many English newspapers have been advocating a more extensive utilization of the telephone. They have pointed out how much more widely and frequently it is used in America than in Britain. The press has repeatedly criticized the British Post Office telephone administration for not going out "to the highways and hedges to fetch the people in." Now, however, Britain's

government telephone service is being extensively advertised; but the extensive advertising is being done by private enterprise.

The Telephone Development Association is quite a recent innovation. For a number of years, however, various British cities have had Telephone Advisory Committees of business men. These have been formed, sometimes under the auspices of local Chambers of Commerce, to act as the representatives of the community in dealing with the telephone authorities. A somewhat similar Advisory Committee on Posts, Telegraphs and Telephones was formed in 1911 in France, as a result, it was said, of "long years of effort" on the part of the Association of Telephone Subscribers. In so far as this Advisory Committee movement makes for intelligent cooperation in the interest of better telephone service, it is undoubtedly a healthy development.

It is obvious, nevertheless, that neither press nor Parliament is equipped for the satisfactory solution of highly technical telephone problems. To leave the settlement of such questions to the hue and cry of newspaper agitation or to the political expediency by which Parliamentary policies are frequently determined, is neither to the advantage of those charged with administering the telephone service nor to the interest of the telephone-using public. Under such circumstances the telephone management is compelled to defend its policies in a forum in which it is practically impossible for it to receive an intelligent and impartial hearing. Even the telephone user is deprived of his "day in court." The public relations of the telephone system inevitably suffer.

Other ill effects of political interference in government telephone administration are seen in matters relating to the discipline of the personnel, and to the restriction of telephone financing by Parliamentary appropriations. In some cases there is reason to believe that

even the program of telephone construction has been affected by political considerations. The maintenance of telephone rates in certain government systems at unremunerative levels, with consequent deficits to be made up by the taxpayers, is apparently attributable to the same cause.

Occasional Investigations

Nor can special investigations of government-owned telephone systems by legislative committees be regarded as an effective remedy for the troubles which tend to develop under public ownership. Such occasional investigations are not uncommon. The Australian Postal Services, including the telephone and telegraph systems, have been successively investigated by a Parliamentary Committee, a Royal Commission, and an investigator appointed by the Postmaster-General. French telephone problems have repeatedly been considered and reported upon by Parliamentary Committees on the Budget and on Public Works and Means of Communication. In the spring of 1923 the condition of the French postal administration in general, and of the telephone system in particular, was the subject of a series of meetings during a period designated as "Posts, Telegraph and Telephone Week," held under the auspices of the President of France. Some very frank criticisms of the service were elicited, not only from representatives of the public, but from government officials as well.

In Great Britain official investigations of Post Office operations have been numerous. The wages of postal employees were considered by investigators in 1897, 1904, 1907, 1913, 1916 and 1921. Telephone rates were touched upon in official inquiries in 1895, 1898, 1920 and 1921. (The British government acquired the long distance telephone lines in 1896, opened local exchanges in London in 1902, and on December 31, 1911, took over the entire local exchange system of the National Telephone Company.)

These Select Committees or special Commissions are authorized only to investigate and to recommend changes. They have no power to enforce their recommendations. If the telephone authorities do not see fit to put the suggestions of such a committee into effect they cannot be compelled to do so, except by the tedious and uncertain process of Parliamentary action; and the whole lengthy and expensive investigation may therefore be practically without result. Eighteen months after the British Select Committee on the Telephone Service, 1922, had submitted its recommendations, the *Morning Post* of London published a statement from a correspondent expressing the opinion that "the net result of the Committee's report does not seem to justify the labor of the experts who conducted the investigation or that of the competent witnesses summoned to give evidence." Generally speaking, short-lived Parliamentary Committees, inquiring into one particular problem of a highly technical business with which they are usually wholly unfamiliar, and with no power to make their decisions effective, can hardly be regarded as a constructive influence.

Public Relations Under Private Enterprise

If, then, telephone systems under public ownership have often failed to maintain satisfactory public relations, what has been accomplished in this regard by telephone services under private ownership and operation?

There are many privately owned telephone systems throughout the world,—in fact they comprise 71% of the world's total telephones. Admittedly, however, the outstanding example of telephone administration by private enterprise is the Bell System in the United States.

From the very beginning of the telephone industry the Bell System has given careful attention to the maintenance of cordial relations with the public which it serves. It could not be truly successful without public good will; and there has, therefore, been every incentive

to earn that good will by giving the public satisfactory service and courteous treatment. The various Bell companies take pride in making public the measures they are employing to meet the ever-increasing demand for telephone service. Their plans for the progressive development of the American telephone system as a nation-wide utility are an open book. They have made known their difficulties as well as their achievements. They have successfully pleaded for public cooperation in trying times, as, for example, during the post-war period, when unavoidable shortages of equipment and of trained personnel for a time impeded progressive telephone development.

In financial matters, particularly, the Bell System policy of complete frankness is in marked contrast to the practice of some governmental telephone services. The periodical financial statements of the Bell System are compiled in accordance with a standard system of uniform accounts prescribed by the regulatory authorities. They are matters of public record. The seeker after information as to the financial results of telephone operation in the United States finds clear and complete data readily available. He is not confronted here, as in some other countries, with telephone accounts in which expenditures for new construction and for maintenance are inextricably intermingled; in which insufficient provision, or no provision at all, has been made for depreciation. He is not compelled to wrestle with financial statements in which a capital account is either lacking or insufficiently used; in which the books are kept on a cash instead of an accrual basis; in which overhead expenses properly chargeable to postal or telegraph operations are lumped with those of the telephone system proper. Accounting practices such as these, which are in vogue in certain countries, largely vitiate international comparisons of the published financial results of telephone operation.

Popular Ownership and Public Relations

One of the most encouraging results of the Bell System policy of full publicity as to financial matters has been the fostering of popular participation in telephone financing. This participation is at once an outgrowth and an instrumentality of good public relations.

The Bell telephone companies have not been unmindful of their obligations toward the great army of small investors who have put their money into telephone stocks and bonds. In cooperation with the Bell Telephone Securities Company, especially organized for the purpose, they have spread information regarding telephone securities among thousands of persons, many of whom do not form a part of the ordinary clientele of banking and investment houses. Great numbers of persons of small means have been aided in purchasing stock of the American Telephone and Telegraph Company, preferred stocks of certain associated companies of the Bell System, and other telephone securities.

Today the American Telephone and Telegraph Company is owned by over 350,000 stockholders,—by far the largest number of stockholders in any corporation in the world,—and of these about 60,000 are telephone employees. In addition to the stockholders in the parent company there are thousands of owners of other Bell telephone securities. In the aggregate, more than 600,000 individuals are owners of Bell System stocks and bonds.

The number of Bell security holders is increasing rapidly. The ownership of the System is becoming more and more widespread. Each new investor who acquires a stake in our nation-wide telephone service feels a personal interest in telephone problems and a personal pride in telephone achievements. This feeling is in striking contrast to the impersonal attitude of the average citizen toward a public utility owned and operated by his government.

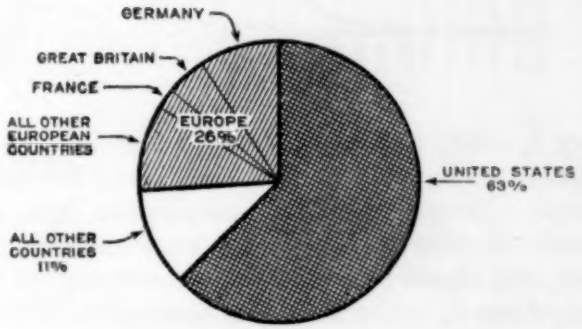
Richard Storrs Coe.

World's Telephone Statistics
January 1, 1924

DURING the year 1923, 1,517,291 telephones were added to the telephone lines and systems throughout the world, an increase of 6.6% compared with an increase of less than 1% in population. On January 1, 1924, the total number of telephones in the world was 24,576,121; of this total 15,369,454, or 63%, were in the United States, although the United States has only about 6% of the world's population. In other words, the United States has one telephone for every 7 of its population, as contrasted with one telephone for every

DISTRIBUTION OF THE WORLD'S TELEPHONES

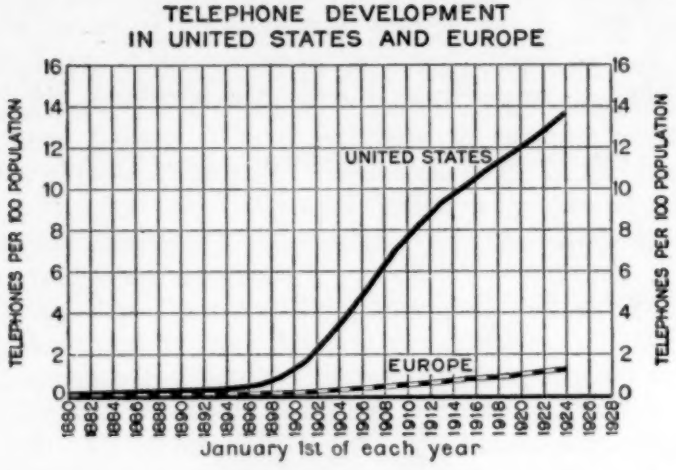
— January 1, 1924 —



185 inhabitants throughout the rest of the world. More than one-half of the net gain in the world's telephones during 1923 occurred in the United States; and of the total number of telephones in this country at the beginning of 1924, 15,000,101, or 98%, were connected to the Bell System.

The net gain in the number of telephones in Europe during 1923 was 520,312, so that on January 1, 1924, Europe had a total of 6,390,765 telephones, or 1.3 per 100 population as against 13.7 in the United States at the same date. Of the 2,815,902 instruments comprising the balance of the world's telephones, 1,009,203 were located in Canada, the remainder being scattered over all other countries in the Western Hemisphere and the continents of Asia, Africa, and Oceania.

The foregoing statistics are taken from a compilation of telephone and telegraph statistics of the world for

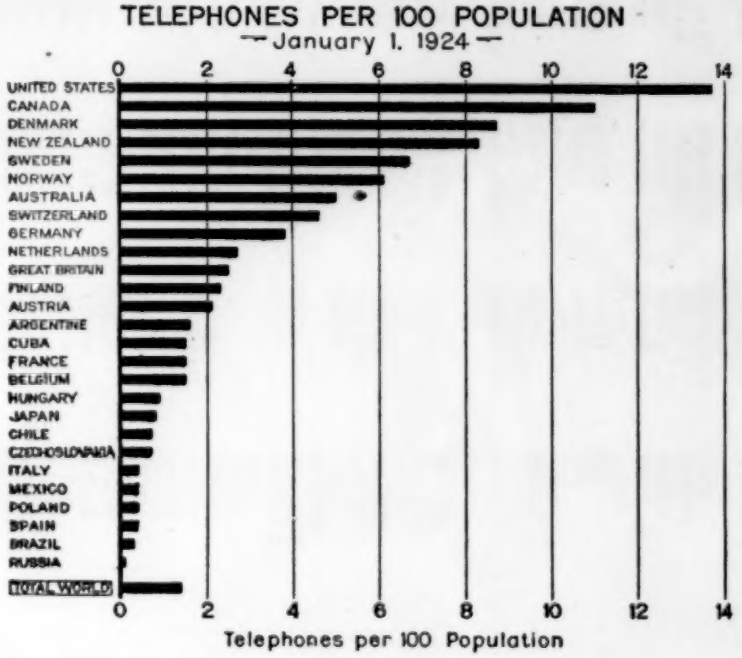


January 1, 1924, which has just been issued by the Chief Statistician's Division of the American Telephone and Telegraph Company. This compilation was prepared from authoritative data received as a result of a thorough canvass, conducted through correspondence, of the telephone systems in each country of the world. The authenticity of the data compensates for the delay in the final summarizations which is necessarily incidental to such a complete survey.

Several of the tables and charts of this compilation are reproduced herewith. The first table shows telephone development by countries, and gives both the

absolute number of telephones and the number in relation to population for all the principal countries. In both absolute and relative number of telephones, the United States occupies a position of unquestioned leadership. It had 62.54% of the world's telephones, whereas Germany, the second country in absolute numbers, had only 9.12% of the total.

For each 100 of its population, the United States had, as already stated, 13.7 telephones. Canada, the majority



of whose telephones are owned and managed under a regime of private enterprise such as prevails in the United States, ranked next with 11.0 telephones per 100 population. Denmark, in which country privately owned telephone systems also dominate, ranked third with 8.7 telephones per 100 population. New Zealand, that small but progressive country in the Southwestern Pacific, ranked fourth, with 8.3. Sweden and Norway with

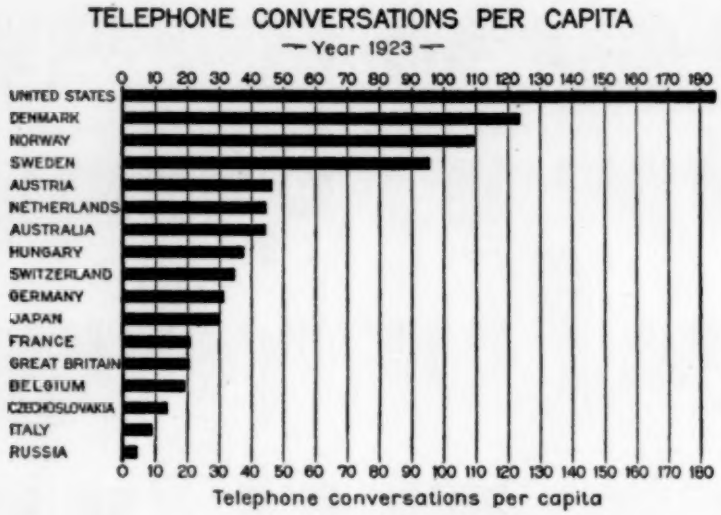
TELEPHONE DEVELOPMENT OF THE WORLD, BY COUNTRIES
January 1, 1924

	Number of Telephones					
	Government Systems	Private Companies	Total	Per Cent. of Total World	Telephones per 100 Population	Increase in Number of Telephones during 1923‡
NORTH AMERICA:						
United States	.....	15,369,454	15,369,454	62.54%	13.7	873,601
Canada	197,926	811,277	1,009,203	4.11%	11.0	65,174
Central America	7,128	10,890	18,018	.07%	0.3	873
Mexico	1,749	48,611	50,360	.20%	0.4	2,431
West Indies:						
Cuba	700	47,086	47,786	.19%	1.5	6,239
Porto Rico	598	10,844	11,442	.05%	0.8	1,071
Other W. I. Places*	3,812	11,302	15,114	.06%	0.3	2,193
Other No. Am. Places*	65	3,600	3,665	.02%	1.1	105
Total	211,978	16,313,064	16,525,042	67.24%	10.9	951,687
EUROPE:						
Austria	135,839	.....	135,839	.55%	2.1	2,439
Belgium	114,807	.....	114,807	.47%	1.5	18,291
Bulgaria	7,283	.....	7,283	.03%	0.1	231
Czechoslovakia	103,606	.....	103,606	.42%	0.7	10,973
Denmark	10,934§	281,836	292,770	1.19%	8.7	16,181
Finland	.....	80,000	80,000	.32%	2.3	9,500
France	603,786	.....	603,786	2.45%	1.5	79,194
Germany	2,242,332	.....	2,242,332	9.12%	3.8	169,024
Great Britain and No. Ireland	1,148,095	.....	1,148,095	4.67%	2.5	102,167
Greece*	5,400	.....	5,400	.02%	0.1	43
Hungary	75,207	.....	75,207	.31%	0.9	4,391
Irish Free State (March 31, 1924)	21,268	.....	21,268	.09%	0.7	1,658
Italy (June 30, 1923)	99,507	43,096	142,603	.58%	0.4	19,037
Jugo-Slavia*	26,000	.....	26,000	.10%	0.2	1,822
Latvia (March 31, 1924)	11,358	.....	11,358	.05%	0.6	3,760
Netherlands	192,184	1,084	193,268	.79%	2.7	8,146
Norway	96,972**	70,036	167,008	.68%	6.1	8,698
Poland	69,211	40,937	110,148	.45%	0.4	10,555
Portugal	2,100*	16,759	18,859	.08%	0.3	872
Roumania	31,615	.....	31,615	.13%	0.2	515
Russia‡‡	130,278	.....	130,278	.53%	0.1	18,278
Spain	28,293	61,707*	90,000*	.37%	0.4	8,050
Sweden	400,691	1,698	402,389	1.64%	6.7	7,854
Switzerland	180,280	.....	180,280	.73%	4.6	12,840
Other Places in Europe*	44,182	12,384	56,566	.23%	0.7	5,793
Total	5,781,228	609,537	6,390,765	26.00%	1.3	520,312

Total	5,781,228	609,537	6,390,765	26.00%	1.3	520,312
SOUTH AMERICA:						
Argentine	.....	157,041	157,041	.64%	1.6	13,948
Bolivia	.....	2,706†	2,706†	.01%	0.1	.....
Brazil	587	93,259	93,846	.38%	0.3	3,734
Chile	.....	30,272	30,272	.12%	0.7	1,274
Colombia	.....	11,463	11,463	.05%	0.2	1,505
Ecuador	1,891	2,821	4,712	.02%	0.2	432
Paraguay	131	261	392	.002%	0.03	-39
Peru	.....	9,140	9,140	.04%	0.2	221
Uruguay	.....	24,184	24,184	.10%	1.5	-213
Venezuela	527	10,023	10,550	.04%	0.4	224
Other Places	2,313	.....	2,313	.01%	0.5	87
Total	5,449	341,170	346,619	1.41%	0.5	21,173
ASIA:						
British India (March 31, 1924)	13,628	25,222	38,850	.16%	0.01	-77
China*	69,189	32,236	101,425	.41%	0.03	9,655
Japan (March 31, 1924)	472,805	.....	472,805	1.92%	0.8	-46,535††
Other Places in Asia*	80,093	14,659	94,752	.39%	0.1	20,603
Total	635,715	72,117	707,832	2.88%	0.1	-16,354
AFRICA:						
Egypt	30,863	.....	30,863	.13%	0.2	2,505
Union of South Africa§	65,183	.....	65,183	.26%	0.9	4,973
Other Places in Africa*	42,449	1,136	43,585	.18%	0.04	3,202
Total	138,495	1,136	139,631	.57%	0.1	10,680
OCEANIA:						
Australia (June 30, 1923)	281,703	.....	281,703	1.15%	5.0	23,226
Dutch East Indies	35,647	2,940†	38,587	.16%	0.1	587
Hawaii	.....	16,816	16,816	.07%	6.0	742
New Zealand (March 31, 1924)	111,441	.....	111,441	.45%	8.3	4,405
Philippine Islands*	2,425	12,575	15,000	.06%	0.1	790
Other Places in Oceania*	2,255	430	2,685	.01%	0.1	43
Total	433,471	32,761	466,232	1.90%	0.7	29,793
TOTAL WORLD	7,206,336	17,369,785	24,576,121	100.00%	1.4	1,517,291

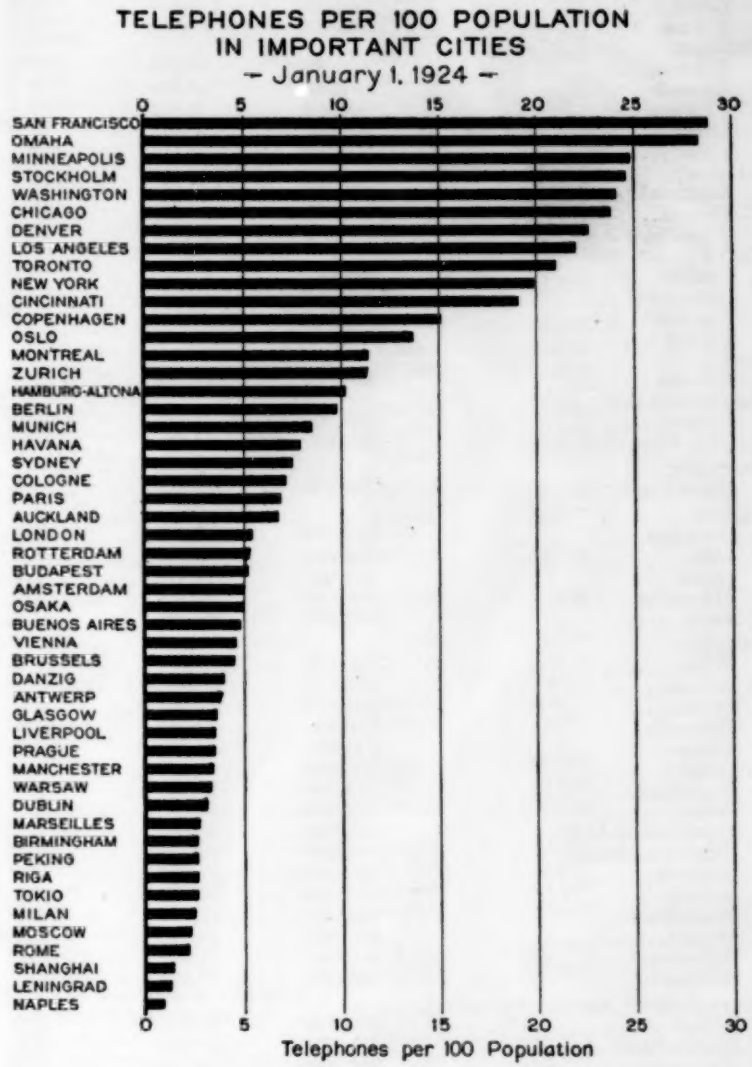
‡Minus sign preceding a figure denotes decrease. *Partly estimated. †January 1, 1923.
§March 31, 1924. **June 30, 1923. ‡‡Including Siberia.
††Decrease due to fact that on March 31, 1924 approximately 70,000 telephones were without service as a result of the earthquake.

ratios of 6.7 and 6.1, respectively, ranked next. Germany, which has been mentioned as having a greater number of telephones than any country other than the United States, had a development of only 3.8 telephones per 100 population. Great Britain, the third country in the world in point of total number of telephones, had only 2.5 per 100 population and in this respect ranked eleventh. The best developed country in South America



was Argentine with 1.6 telephones per 100 population, followed closely, however, by the smaller country of Uruguay with 1.5 telephones per 100 of its people. There was a decrease in telephones in the Orient due to the disastrous earthquake of September, 1923, in Japan, as a result of which nearly 70,000 telephones in that country were still out of service on March 31, 1924. Japan's development, however, has never reached as much as one telephone for each 100 of its inhabitants. In China, where the telephone is still almost unknown, there were but 101,425 telephones to serve 400,000,000 people; but Australia to the South had 281,703 telephones, or 5 telephones per 100 population.

It is not surprising that this compilation shows that the annual number of telephone conversations per capita



in the United States exceeds that in other countries. Many telephones mean many conversations, and the effect, in turn, becomes the cause, so that many conver-

TELEPHONE DEVELOPMENT OF IMPORTANT CITIES
January 1, 1924

Country and City (or Exchange Area)	Estimated Population (City or Exchange Area)	Number of Telephones	Telephones per 100 Population
ARGENTINE:			
Buenos Aires	1,811,000	87,213	4.8
AUSTRALIA:			
Adelaide	279,000	19,934	7.1
Brisbane	236,000	15,523	6.6
Melbourne	853,000	61,111	7.2
Sydney	981,000	73,494	7.5
AUSTRIA:			
Gratz	154,000	5,926	3.8
Vienna	1,885,000	87,440	4.6
BELGIUM:			
Antwerp	466,000	18,118	3.9
Brussels	878,000	39,599	4.5
Charleroi	209,000	3,882	1.9
Ghent	279,000	5,398	1.9
Liege	298,000	8,470	2.8
CANADA:			
Montreal	940,000	107,459	11.4
Ottawa	171,000	29,629	17.4
Toronto	611,000	128,496	21.0
CHINA:			
Canton	909,000	2,570	0.3
Shanghai	1,530,000	21,770	1.4
Tientsin	816,000	7,410	0.9
Peking	1,326,000	34,000*	2.6
CUBA:			
Havana	432,000	34,276	7.9
CZECHOSLOVAKIA:			
Prague	690,000	24,291	3.5
DANZIG, FREE CITY OF	369,000	14,615	4.0
DENMARK:			
Copenhagen	746,000	112,709	15.1
FRANCE:			
Bordeaux	273,000	9,565	3.5
Lille	205,000	7,574	3.7
Lyons	574,000	14,116	2.5
Marseilles	598,000	15,986	2.7
Paris	2,965,000	207,861	7.0
GERMANY:			
Berlin	3,880,000	381,291	9.8
Bremen	276,000	25,500	9.2
Breslau	538,000	33,342	6.2
Chemnitz	310,000	18,040	5.8
Cologne	646,000	46,593	7.2
Dresden	600,000	43,841	7.3
Düsseldorf	415,000	30,632	7.4
Essen	447,000	17,708	4.0
Frankfort-on-Main	441,000	45,383	10.3
Hamburg-Altona	1,179,000	120,756	10.2
Hanover	401,000	27,997	7.0
Leipzig	616,000	50,252	8.2
Magdeburg	292,000	17,619	6.0
Munich	643,000	54,716	8.5
Nuremburg	361,000	27,511	7.6
Stuttgart	315,000	27,525	8.7
GREAT BRITAIN AND NO. IRELAND:†			
Belfast	422,000	10,889	2.6
Birmingham	1,311,000	33,460	2.6
Blackburn	256,000	5,784	2.3
Bolton	287,000	6,000	2.1
Bradford	387,000	14,806	3.8
Bristol	417,000	11,618	2.8
Edinburgh	432,000	18,368	4.3
Glasgow	1,298,000	46,158	3.6
Hull	334,000	14,114	4.2
Leeds	552,000	15,668	2.8
Liverpool	1,226,000	43,361	3.5
London	7,282,000	396,524	5.4
Manchester	1,639,000	55,795	3.4
Newcastle	615,000	15,457	2.5
Nottingham	344,000	10,880	3.2
Plymouth	237,000	4,716	2.0
Sheffield	520,000	13,499	2.6

*Partly estimated.
†March 31, 1924.

TELEPHONE DEVELOPMENT OF IMPORTANT CITIES—(*Concluded*)

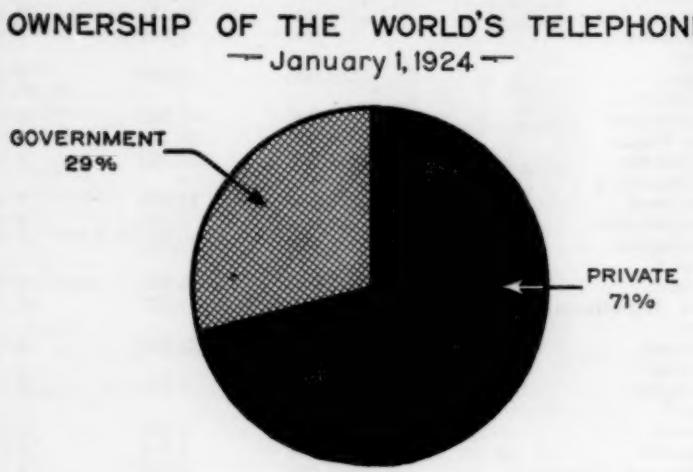
January 1, 1924

Country and City (or Exchange Area)	Estimated Population (City or Exchange Area)	Number of Telephones	Telephones per 100 Population
HUNGARY:			
Budapest	944,000	49,151	5.2
Szegedin	112,000	2,028	1.8
IRISH FREE STATE:†			
Dublin	399,000	12,500*	3.1
ITALY§			
Florence	251,000	4,600	1.8
Genoa	305,000	8,347	2.7
Milan	714,000	17,992	2.5
Naples	785,000	6,786	0.9
Palermo	408,000	2,787	0.7
Rome	648,000	14,261	2.2
Turin	509,000	7,953	1.6
Venice	169,000	2,598	1.5
JAPAN:†			
Kobe	695,000	21,690	3.1
Kyoto	658,000	20,474	3.1
Nagoya	655,000	18,127	2.8
Osaka	1,385,000	69,419	5.0
Tokio	2,265,000	58,324	2.6
Yokohama	447,000	3,949	0.9
LATVIA:			
Riga	285,000	7,315	2.6
NETHERLANDS:			
Amsterdam	706,000	35,360	5.0
The Hague	383,000	26,599	6.9
Rotterdam	537,000	28,692	5.3
NEW ZEALAND:†			
Auckland	173,000	11,696	6.8
Christchurch	115,000	9,238	8.0
Wellington	115,000	12,751	11.1
NORWAY:§			
Bergen	97,000	8,736	9.0
Oslo (Christiania)	262,000	35,937	13.7
POLAND:			
Warsaw	944,000	31,280	3.3
ROUMANIA:			
Bucharest	357,000	8,940	2.5
RUSSIA:			
Kazan	160,000	1,054	0.7
Kharkov	322,000	2,614	0.8
Leningrad (Petrograd)	1,082,000	14167	1.3
Moscow	1,543,000	35,078	2.3
Odessa	324,000	1,287	0.4
SWEDEN:			
Göteborg	229,000	26,372	11.5
Malmö	116,000	13,544	11.7
Stockholm	430,000	105,733	24.6
SWITZERLAND:			
Basel	136,000	13,090	9.6
Berne	104,000	11,277	10.9
Geneva	130,000	14,451	11.1
Zurich	201,000	22,976	11.4
UNITED STATES:‡			
New York	5,972,000	1,186,573	19.9
Chicago	2,909,000	691,488	23.8
Total of the 7 cities with over 1,000,000 population	15,789,000	3,080,412	19.5
Los Angeles	995,000	218,662	22.0
San Francisco	650,000	187,452	28.8
Cincinnati	642,000	122,660	19.1
Total of the 10 cities with 500,000-1,000,000 population	6,794,000	1,217,290	17.9
Washington	460,000	110,969	24.1
Minneapolis	430,000	106,798	24.8
Denver	294,000	66,877	22.7
Omaha	215,000	60,870	28.3
Total of the 26 cities with 200,000-500,000 population	7,676,000	1,392,167	18.1
Total of the 43 cities with over 200,000 population	30,259,000	5,689,869	18.8

†March 31, 1924. *Partly estimated. §June 30, 1923.

‡In addition to New York and Chicago, the largest cities, there are shown, for purposes of comparison with cities in other countries, the total development of all cities in the United States in certain population groups and the development of certain representative cities within each of such groups.

sations augment the demand for new telephones. There were 184.5 telephone conversations per capita in the United States during 1923, and, as seen by the chart reproduced herewith, Europe outside of the Scandinavian countries, had no country reporting as many as 50 conversations per capita. The Scandinavian countries—Denmark, Norway, and Sweden—ranked next to the United States with 123.7, 109.6, and 95.8 conversations



per capita, respectively. Germany had only 31.1 conversations, while Great Britain and France had no more than 20.4 and 20.8, respectively. Italy showed only 9.0 conversations per capita, while Russia, with 4.4 conversations per capita during the year, ranked last of the countries reported.

The table on "Telephone Development of Important Cities" shows that, outside of the United States, Canada, and Sweden, there is no city with more than 20 telephones per 100 population, and none outside the United States with more than 25 telephones per 100 population. In fact, it is quite rare to find a city outside the United States or Canada with more than 10 telephones per 100 population. Paris, the fashion center of the world, had

only 7.0 on January 1, 1924, London but 5.4, Rome merely 2.2 telephones per 100 population. The capital cities of Scandinavia, however, were better equipped with telephones, headed by Stockholm with 24.6 per 100 population, Copenhagen and Oslo following with 15.1 and 13.7, respectively. In the 43 cities in the United States which had a population of 200,000 or over, there was on an average 18.8 telephones per 100 population. Many of these cities had more telephones than there were in the whole of most foreign countries. For instance, New York had more than Great Britain and Northern Ireland; Chicago more than France; San Francisco more than Switzerland; Cincinnati more than New Zealand, etc. Indeed, there is no foreign country, other than Germany, which is not surpassed by one or more single American city in point of number of telephones.

The accompanying chart shows that 71% of the world's telephones are operated by private enterprise as compared with only 29% under Government ownership; and it will be noted from the first table that the best developed countries in the world from a telephone standpoint—the United States, Canada, and Denmark—are those in which private operation still predominates.

C. W. Foss

Abstracts of Recent Technical Papers from Bell System Sources

Radioactivity,[1] by A. F. Kovarik and L. W. McKeehan. This review of progress in radioactivity forms one of a series of monographs prepared by committees of the National Research Council. It outlines the experimental and theoretical advances in the subject since 1916, the date of the last compendium. The section headings are: I. Introduction, II. Radioactive Transformations, III. Alpha-Rays, IV. Beta-Rays, V. Gamma-Rays, VI. Nuclear Structure and Radioactive Processes, VII. Radioactivity in Geology and Cosmology, VIII. The Effects of Radioactive Radiations upon Matter. The references to periodical literature are particularly detailed.

The Transmission of Pictures Over Telephone Lines,[2] by H. E. Ives, J. W. Horton, R. D. Parker and A. B. Clark. In the July 1924 and the April 1925 issue of the *Quarterly* appeared reports of public demonstrations of the Bell Telephone System of transmitting pictures over telephone wires. In the present paper, a complete account of the technical phases of the picture transmission system is given.

The broad principles of picture transmission have been recognized for many years. Their production from successful practice, however, required, among other things, perfection of methods for the faithful transmission of electrical signals over long distances and the development of special apparatus and methods which have become a part of the communication art only within the last few years. Prominent among the newer developments which have facilitated picture transmission are the photo-electric cell, the vacuum tube amplifier, electrical filters and the use of carrier current. The present paper gives a general idea of the incorporation of these new developments in the picture transmission art.

[1] Bulletin National Research Council, Vol. 10, Part 2, March 1925, 203 pages.
[2] Bell System Technical Journal, Vol. 4, p. 187, April 1925.

None of the systems heretofore devised have been sufficiently developed to meet the requirements of modern commercial service. The picture transmission system described has been designed for practical use over long distances, employing facilities of the time made available by the network of the Bell System.

The desirability of adding a picture transmission service to the other communication facilities offered by the Bell System is now receiving a commercial trial, sending and receiving apparatus having been installed for regular service at New York, Chicago, and San Francisco.

The Telephone Transmission Unit,[3] by Dr. F. B. Jewett. The adoption by the Bell System of the TU as a telephone transmission unit aroused considerable, active discussion in foreign circles, namely, by Colonel Purves, Engineering Chief of the British Post Office Department, and Dr. Breisig of the German Telephone Administration. In this short paper, Dr. Jewett explains certain words and expressions which, when accurately defined, he believes will eliminate misinterpretations such as seem to have led to the controversies over the Bell System TU.

Dr. Jewett also points out that the numerical size for a transmission unit is controlled by two factors; first, the magnitude should be such that computation is convenient, and second, the magnitude should be such as to permit telephone engineers and operating people to most readily comprehend the ratios corresponding to any given number of units. Since it is desirable that every unit be based on a decimal system of notation, unless there is some very important reason why it should not, the TU based on the decimal system was chosen. Satisfactory experience during the past year and a half is pointed to as showing the wisdom of having chosen the TU.

[3] London Electrician, Vol. 94, p. 562, 1925.

Echo Suppressors for Long Distance Telephone Circuits,[4] by A. B. Clark and R. C. Mathes. This paper gives a brief description of a device which has been developed by the Bell System for suppressing "echo" effects which may be encountered under certain conditions in telephone circuits which are electrically very long. The device has been given the name "echo suppressor" and consists of relays in combination with vacuum tubes which are operated by the voice currents so as to block the echoes without disturbing the main transmission.

A number of echo suppressors have been operated on commercial telephone circuits for a considerable period, so that their practicability has been demonstrated.

Propagation of Electric Waves Over the Earth,[5] by H. W. Nichols and J. C. Schelleng. The comparatively poor transmission of radio waves of two or three hundred meters indicates some sort of selective effect in the atmosphere. Such an effect is found to result from the existence of free electrons in the atmosphere when the magnetic field of the earth is taken into account. In the earth's magnetic field, which is about one-half gauss, this selective effect will occur at a wave length of approximately 200 meters. Ionized hydrogen molecules or atoms result in resonant effects at frequencies of a few hundred cycles, this being outside of the radio range. The paper, however, takes into account the effects of ionized molecules as well as electrons.

The result of this combination is that the electric vector of a wave traveling parallel to the magnetic field is rotated. Waves traveling perpendicular to the magnetic field undergo double refraction. Critical effects are observed in rotation, bending of the wave and absorption at the resonant frequency. The paper develops the mathematical theory of these phenomena and gives formulas for the various effects to be expected.

[4] Journal A. I. E. E., Vol. 44, p. 618, 1925.

[5] Bell System Technical Journal, Vol. 4, p. 215, 1925.

Power Amplifiers in Transatlantic Radio Telephony,[6] by A. A. OSWALD and J. C. SCHELLENG. The paper describes the development of a 150-kilowatt (output radio frequency amplifier installation built for transatlantic telephone tests. The characteristics of the single-sideband eliminated-carrier method of transmission are discussed with particular reference to its bearing upon the design of the power apparatus. A classification of amplifiers is proposed in which there are three types distinguished from each other by the particular portion of the tube characteristic used. The water-cooled tubes employed in these tests are briefly described, special consideration being given to their use in a large installation. The system is then shown in outline by means of a block diagram, the elements of which are subsequently discussed in greater detail. The theory, electrical design, and mechanical construction of the last two stages of the amplifier are outlined, including the output and antenna circuits. Means employed to prevent spurious oscillations are described. The method used in increasing the transmission band width to a value much greater than that of the antenna is explained. The power requirements of a single sideband installation are outlined and a description of the six-phase rectifier used as a source of high potential direct current is given, together with a brief theoretical treatment of its operation. Circuit diagrams, photographs, and a number of characteristic curves are discussed.

Production of Single Sideband for Transatlantic Radio Telephony,[7] by R. A. HEISING. This paper describes in detail the equipment and circuit used in the production of the single sideband for transatlantic radio telephony in the experiments at Rocky Point. The set consists of two oscillators, two sets of modulators, two filters, and a three-stage amplifier. The oscillators and modulators operate at power levels similar to those in high-frequency

[6] Proc. of I. R. E., Vol. 13, page 313, June 1925.
[7] Proc. of I. R. E., Vol. 13, page 291, 1925.

communication on land wires. The three-stage amplifier amplifies the sideband produced by these modulators to about a 500-watt level for delivery to the water-cooled tube amplifier.

The first oscillator operates at about 33,700 cycles. The modulator is balanced to eliminate the carrier; and the first filter selects the lower sideband. In these transatlantic experiments the second oscillator operated at 89,200 cycles, but might operate anywhere between 74,000 and 102,000 cycles. The second modulator, which is also balanced, is supplied with a carrier by the second oscillator and with modulating currents by the first modulator and first filter. The second filter is built to transmit between 41,000 and 71,000 cycles, so that by varying the second oscillator, the resulting sideband, which is the lower sideband produced in the second modulating process, may be placed anywhere between these two figures. Transmission curves for the filters are given as well as some amplitude-frequency performance curves of the set.

A Suspension for Supporting Delicate Instruments,[8] by A. L. JOHNSRUD, Bell Telephone Laboratories, Incorporated, New York. A description, with diagram, is given of a modified Julius suspension designed especially to eliminate disturbances due to vertical vibrations from the building structure. The frame holding the instrument is supported by a system of tape-wound coil springs, which, because of the tightly wound friction tape, damp out mechanical vibrations. The frame, with its balancing weights, is heavy (about 120 pounds), and so proportioned in mass that a twisting or tilting impulse, necessary at times in adjusting the instrument, disturbs its moving system only in a secondary degree. This is a second feature of this suspension. Surprisingly effective kinetic insulation is achieved. Quadrant electrometers and a moving magnet galvanometer have remained undisturbed even when heavy trucks were passing on the

[8] Journal Opt. Soc. of Am. Vol. X, No. 5, pp. 609-611, May 1925.

street seven floors below. This type of suspension, developed some years ago through the efforts of Mr. H. C. Harrison and Mr. J. P. Maxfield, has been adopted for use throughout the Bell Telephone Laboratories in a variety of ways.

A Null-Reading Astatic Magnetometer of Novel Design,[9] by RICHARD M. BOZORTH. This instrument is designed for measuring the magnetic properties of very small amounts of material in the form of fine wires, thin tapes, or as thin deposits (electrolytic, evaporated, sputtered) supported on non-magnetic forms. The specimen, 4 cm. long, is mounted parallel to the line joining the two needles so that its poles produce the maximum torque on the suspended needle system, the position of which is read by mirror and scale. The effect of the magnetizing coil on the needles is annulled once for all by the suitably placing of an auxiliary coil, and the magnetic effect of the sample itself is balanced by passing a measured current through a third coil. The applied field and the induced magnetization are then proportional to the electric currents passed through the magnetizing coil and the balancing coil, respectively. A hysteresis loop is shown, obtained from an iron wire weighing 3 mg.

An Explanation of Peculiar Reflections Observed on X-ray Powder Photographs,[10] by RICHARD M. BOZORTH. There has been previously reported (J. O. S. A. and R. S. I. 6,989-97; 1922) the existence of "anomalous" reflections of X-rays, observed when analyzing substances by the method of Debye-Scherrer and Hull. These reflections are now explained in accordance with the well-known laws governing X-ray reflections. It is shown that the molybdenum X-ray spectrum as ordinarily used, although it is filtered by zirconium screens, contains in addition to the characteristic $K\alpha$ radiation a considerable amount of general radiation. Although usually not effective, this general radiation becomes im-

[9] J. O. S. A. and R. S. I. Vol. 10, 591-8, May, 1925.
[10] J. O. S. A. and R. S. I. Vol. 9, 123-7, August, 1924.

portant when the sample being analyzed is composed of crystal grains of certain sizes. The effect under discussion is caused by reflection of this general radiation from the principal atom planes of these crystals. Several experiments, and a geometrical analysis of the positions and orientations of the diffraction effects, confirm this conclusion.

Notes on Recent Occurrences

PUBLICITY CONFERENCE

A GENERAL conference of those in charge of Bell System publicity matters was held at Briarcliff Lodge, New York, April 14 to 18, 1925. It was attended by the publicity managers and advertising managers of the American Telephone and Telegraph Company, the associated Bell companies, the Western Electric Company, and the Bell Telephone Laboratories; the staff of the American Company's Information Department, and the editors of the various employee magazines published in the System.

Publicity Department activities were discussed in detail, particular attention being given to the co-ordination of local and national institutional advertising, newspaper advertising of special features of long distance telephone service, motion picture publicity, and public announcements relative to rate schedule adjustments. Chairman H. B. Thayer and President W. S. Gifford, of the American Company, addressed the conference on the scope and functions of publicity in telephone operation; Vice-Presidents Guernsey and Houston discussed broad aspects of publicity and public relations; Mr. T. G. Miller, General Manager of the Long Lines Department, informed the conference of new operating methods that were resulting in greatly improved long distance service.

There was free exchange between members of experiences and ideas both as to publicity methods and policies which could be put into practise during the coming year. It was also developed that since the previous conference much progress had been made in co-ordinating the varied publicity activities of the Bell System so that they should be more effective for the common good.

The conference ended with a visit to the Bell Telephone Laboratories.

THE TELEPHOTOGRAPH AS AN AID TO THE POLICE

SOME interesting experiments in the use of the telephotograph service for the identification of criminals were carried on during the meeting of the International Police Conference in New York, May 12 to May 16.

The Identification Bureau of the New York Police Department had previously given some attention to the sending of pictures over telephone wires in order to get quick identification of criminals from the police departments of distant cities. This led Commissioner Enright to ask that a demonstration of the telephotograph be given for the benefit of the visiting police heads of the American cities and some forty or fifty representatives from the leading police departments of foreign countries.

As a first step toward carrying out this plan, certain rigid tests of the telephotograph transmission of finger-prints were made and proved so satisfactory that Captain Golden of the New York Police Department in charge of the finger-print division, was convinced that legal action could be taken on the basis of the telephotograph evidence.

Sending apparatus, which fortunately was available at that time, was installed at the headquarters of the Police Conference at the Waldorf Astoria Hotel.

On May 13 a committee, appointed by the Conference, selected three of the criminal records in the New York Police files, and a single finger-print of each of the three criminals, together with the established formula of classification, was sent by wire to Chief Collins in Chicago. The pictures of these finger-prints as received over the wire were identified by the Chicago Police Department without difficulty, and the full description and criminal record of the three criminals were given to the Conference over the long distance telephone lines from Chicago to New York connected to the loud-speaker equipment in the Conference room.

A description of the process of transmitting pictures by wire with some mention of the research work of the Bell Telephone Laboratories and the extension by the Bell System of communication facilities which the police could avail themselves of throughout the United States, was given by General J. J. Carty in a short address. This address was supplemented by stereopticon pictures of the picture-transmitting apparatus and of finger-prints and other subjects transmitted.

Among the slides shown was a picture of a section of the first treaty between Japan and the United States written in the Japanese language. This text had been transmitted over the long distance telephone wires between New York and Chicago, and is believed to be the first example of a telegraph message sent in the original Japanese characters. When this telephotograph print was thrown upon the screen, the representative from Japan spoke up with much enthusiasm, confirming the authenticity of this Japanese writing.

The foreign delegates expressed themselves to Commissioner Enright as being greatly interested and instructed by the demonstration of the American Telephone and Telegraph Company.

TELEPHOTOGRAPH DEMONSTRATION TO AMERICAN MEDICAL ASSOCIATION

The usefulness of telephotograph service to the medical profession was demonstrated on May 28 in the theater on the Steel Pier in Atlantic City before 1,500 physicians who were attending the annual meeting of the American Medical Association.

The demonstration took the form of a long distance clinic, Dr. James R. Greer, in Chicago, giving a diagnosis over long distance telephone lines of pictures charting a patient's heart action, that had been transmitted to him that morning by the telephotograph method. By means of the public address system installed in the

theater, the entire audience of physicians heard his diagnosis and the ensuing discussion of it by Dr. Alexander Lambert, of New York, who acted as chief-of-clinic.

The apparatus by which heart beats may be observed visually or recorded photographically was developed by specialists of the Bell Telephone Laboratories in co-operation with Dr. H. B. Williams, of the Physiological Laboratory of Columbia University, and was on exhibition in the convention's scientific section.

Prior to the general demonstration of the telephotograph system on May 28, a picture showing both a cardiogram and stethogram had been sent by wire to Dr. Greer, and his diagnosis, in the form of a letter, had been telephotographed back and copies of both telephotographs were distributed to the physicians attending the clinic.

GENERAL TRAFFIC CONFERENCE

THE fifth conference of General Traffic Managers and Superintendents was held at Shawnee-on-Delaware from June 3 to June 12. In addition to the heads of the traffic departments, some of the men in the principal staff positions and some of those in charge of the larger operating divisions also attended. For the first time, the Chief Engineers and the Traffic Engineers attended the General Traffic Conference, and in view of the importance of service and operating factors in many engineering problems, it is thought that the discussion of these problems by both engineers and operating people was distinctly beneficial to both.

Both in respect to service and to the efficiency of traffic operations, there has been steady improvement since the war, and the results in 1924, and so far in 1925, are the best of which there is record. The conference was called primarily, however, to consider ways in which further improvements can be made, and the mat-

ters presented and the discussion were directed to that end, with the result that many promising suggestions were considered.

Conditions are now as favorable for good traffic operations as they have been since the war, but a good deal of attention was given to the further strengthening of traffic organizations and to a review of methods of administration so as to be prepared for less favorable conditions which are bound to be encountered sooner or later in the changing cycles of business and employment conditions.

Service problems are most difficult in metropolitan areas where the large growth in telephone stations and volume of business to be handled is steadily increasing the complexity of all telephone problems. Particular attention was paid to these situations and improved methods are already becoming available which will counteract some of the increasing complications in these areas.

In no phase of traffic work has there been greater progress than in the handling of toll and long distance calls, but from the nature of these calls we are always hopeful of further improvements. A number of improved methods are already under trial and all suggestions as to possible modifications in toll methods were considered in detail.

With a total force of about 160,000 people, very largely women, there are many problems in connection with their training and handling, and two days of the conference were devoted to these subjects, having particularly in mind the well-being of this large operating force.

The expense of traffic operation is large, calling for carefully thought out plans of administration to avoid waste. The efficiency of operation at the present time is exceptionally good, but the whole matter of traffic budgets and expense programs was reviewed carefully.

In the consideration of all problems before the traffic conference, as was the case in the other conferences held

this spring, particular attention was paid to the view which the subscribers take of all matters affecting their service and where it is practicable to give a service which will be more satisfactory and more pleasing to subscribers, the methods and manner of operation will be modified to that end.

OPERATING CONFERENCE

A CONFERENCE was held at Absecon, N. J., from April 29 to May 8, which was attended by the head of the operating department, either Vice President or General Manager, as the case might be, of each of the Associated Companies in the Bell System.

The results of operation in 1924 were analyzed from all angles and the provisional estimates for 1925 and the succeeding years were gone over in detail. With the continued large growth in telephone stations and the present high costs of material and labor, problems of plant extensions have assumed even greater importance, and this matter was given special attention. For the most efficient operation of plant, manufacturing and installation forces, it is desirable to avoid wide fluctuations in the amount of plant extension work done year by year, and ways were pointed out of taking advantage of the less active periods to get ahead somewhat so as to handle the additions in periods of heaviest growth with less extraordinary effort and expense.

Traffic, plant and commercial results in 1924 and general engineering matters were each reviewed including the outlook for the next few years. In all cases, there has been steady improvement for the last few years with results in 1924 better than in any of the preceding years. In the case of all operations, however, suggestions were made as to ways in which further improvements might be possible, and the directions in which progress seems most likely were discussed and agreed upon.

The installation of machine switching is going ahead steadily, and at the present time 1,300,000 stations are operated from that system. The service of this machine switching equipment is satisfactory, and its other operating features and results in accordance with expectations.

While specialization is necessary in an organization as large as the Bell System and the efficiency of company operation must be based on efficiency in various departments, precautions were outlined to avoid over-specialization, to ensure a broad consideration of telephone problems and to further the development of all-around telephone men. There was thorough discussion of further improvement in all telephone organizations and the development of an adequate supervisory personnel.

Consideration was given to all problems affecting the large personnel of the System, including the organization for health promotion and the further improvement in the already favorable showing as to accidents.

There were interesting talks on the distribution of telephone stock ownership, on the responsibilities of the various operating departments in connection with rate matters, on the relation of publicity to operations, and on the present activities in connection with radio.

A large part of the time of the conference was given to a broad consideration of service, including not merely the traffic operations, but all others that make up the service which the telephone company provides for its patrons. Many suggestions looking to further improvements were outlined and discussed and methods of procedure to determine the action to be taken were agreed upon. From the subscriber's viewpoint, service is the most important feature of the telephone business, and while the subscribers' wishes have always been given consideration in building up methods of operation, the service was reviewed from the angle of the conferees putting themselves in the position of subscribers and looking at telephone service solely from that point of view,

disregarding for the moment the technical problems and difficulties of giving service. This action resulted in important discussions as to ways in which a service might be provided which would be more satisfying and more pleasing to subscribers.

THE PRESIDENTS' CONFERENCE

IMPROVEMENT of telephone service from the standpoint of the telephone user was the principal topic at the Presidents' Conference at Yama Farms, which convened on May 22nd and continued for six days.

Telephone service from a technical viewpoint has not only been much improved in recent years, but it has been improved in spite of the increasing difficulties which have resulted from the rapid growth of the number of subscribers connected with the System. Besides the complications which come from vastness of the service demands, there have been difficulties resulting from greater distances covered by toll connections and from the use of carrier currents, repeaters and many new methods which result in efficiency and economy, but which the operating forces have had to learn to use.

The technic of telephone service has been constantly studied by traffic experts, and if their reports at any time show a failure to meet the established standards, proper means are taken to restore the service to normal.

From the technical viewpoint, therefore, the work of improving the service never ceases and the traffic experts are the best judges of its quality and are the first to know what improvements are necessary.

The subscriber on the other hand knows little of what goes on in the traffic department, but nevertheless he has standards of his own. A single case of poor service may mean more to the subscriber than a high average showing over a long period of time. It may be that the subscriber has difficulty in using the directory, or

he may move and have delay in obtaining a new telephone, or he may not like the method of billing, or the attitude of some telephone company representative.

In dealing with so many millions of subscribers there are a number of mistakes or accidents which may happen to produce dissatisfaction on the part of some individuals. Also it is possible that some practices which, approved from the standpoint of economy, may be not approved by subscribers. This whole matter was gone into by the conference and a number of useful suggestions were developed.

Various problems and plans that had to do with telephone operation were discussed in some detail, all with the purpose of giving service which will meet the needs and the desires of the subscribers.

Some attention was given to a better understanding between regulatory bodies, public officials, the public and the Bell System, also to the further development of the personnel policy and to ways and means for discovering, placing and continuously developing those in the organization who showed talent. The development and research results for 1924 and plans now under way were considered, as were the general results of operations last year. In all directions good results were recorded with favorable prospects for the current year.

BELL SYSTEM EDUCATIONAL CONFERENCE

DURING the week of June 22–27, 1925, an educational conference was held at Chicago, Ill. On invitation of the American Telephone and Telegraph Company, the Illinois Bell Telephone Company and the Western Electric Company, fifty-three educational institutions from every section of the country were represented by sixty-eight professors of mechanical engineering, among whom were twenty-two deans of engineering colleges. This conference sought to bring about a more thorough appreciation of telephone engi-

neering on the part of mechanical engineers, as the educational conference of August, 1924, had had for its objective the presentation of telephone engineering from the standpoint of electrical engineering.

The mechanical features of both manual and machine switching systems, together with the fundamental engineering problems of an operating telephone company, were discussed during the first two days of the conference. The opportunities for mechanical engineers in manufacture of telephone apparatus were presented in papers by Western Electric engineers, which were supplemented by observation trips through the Hawthorne plant.

In addition to the general advantages accruing from personal contact and discussion of mutual problems, there were several important facts brought out in this conference. At the close, there was no question in the minds of the visiting professors that telephone engineering is broad and diversified; that it offers splendid opportunity for the adaptation of broad engineering principles, whether they be in the realm of electrical, mechanical or civil engineering; and that in all engineering the problem of economics is deep-seated. The telephone companies desire only to present their problems to the educator and invite him to see and study, at first hand, these problems; they do not seek to tell what should be taught or how the teaching shall be done. That is the problem of the educator.

Organization Changes

Indiana Bell Telephone Company

F. A. Montrose appointed General Manager.

Entered the employ of the Bell System with the Chicago Telephone Company, July, 1907; District Plant Engineer, Pacific Telephone and Telegraph Company, Spokane, Wash., June, 1909; Southwestern Bell Telephone Company, Plant Engineer, Kansas City, Mo., August, 1912; Central Union Telephone Company, Plant Engineer, Chicago, July 1919; General Plant Superintendent, Indianapolis, March, 1920; Indiana Bell Telephone Company, General Superintendent of Plant, Indianapolis, July, 1920; General Superintendent of Plant and Chief Engineer, January, 1922; General Manager, May, 1925.

W. H. Curran appointed Chief Engineer.

Entered the employ of the Bell System with the Pacific Telephone and Telegraph Company, February, 1907; Engineering Department, Portland, Ore., 1910; transferred to Seattle, Wash., 1912; in military service, 1917 to 1919; re-entered employ of the Pacific Telephone and Telegraph Company, 1919; Central Union Telephone Company, General Outside Plant Engineer, November, 1919; Indiana Bell Telephone Company, in a similar capacity, November, 1920; Chief Engineer, May, 1925.

J. W. Hannon appointed General Superintendent of Plant.

Entered the employ of the Missouri and Kansas Telephone Company, Leavenworth, Kansas, November, 1905; Division Wire Chief, Kansas City, 1913; assigned to Chief Engineer's Office, Chicago, 1919; Indiana Bell Telephone Company, District Plant Chief, South Bend, Ind., April, 1920; Plant Supervisor, Indianapolis, 1921; Division Plant Superintendent, Indianapolis Division, 1922; General Superintendent of Plant, May, 1925.

NORTHWESTERN BELL TELEPHONE COMPANY

Frank E. Randall elected Vice-President.

Entered the employ of the Bell System as General Counsel, Northwestern Bell Telephone Company, Omaha, May, 1921; Vice-President, June, 1925.

H. I. Dodson appointed Chief Engineer.

Entered the employ of the Bell System as Outside Plant Engineer, New York Telephone Company, Brooklyn, N. Y., August, 1907; District Plant Engineer, Buffalo, October, 1909; Division Plant Engineer, Buffalo, July, 1914; Estimate Engineer, Northwestern Group, July, 1920; Outside Plant Engineer, Northwestern Bell Telephone Company, September, 1921; Chief Engineer, June, 1925.